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Vol. 87
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Vol. 87 JULY–AUGUST 1960 No. 4

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Bulletin

of the

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Published for the Club bi-monthly

by

THE BUSINESS PRESS, INC.
N. QUEEN ST. AND McGOVERN AVE.
LANCASTER, PENNSYLVANIA

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The Index to American Botanical Literature is printed on cards by G. K. Hall & Co., 97 Oliver St., Boston 10, Mass. to whom inquiries and orders should be sent.

Entered as second-class matter October 8, 1940 at the post office at Lancaster, Pa., under the Act of March 3, 1879. Accepted for mailing at the special rate of postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 87, NO. 4, PP. 247–257 JULY, 1960

SPHENOBAIERA IKORFATENSIS F. PAPILLATA FROM THE LAKOTA FORMATION OF THE BLACK HILLS[1]

ELIZABETH J. CAHOON

The identification of this ginkgophyte from the lower portion of the Lakota formation is the only recent addition to our meager knowledge of the plants which flourished along the South Dakota coast of the transgressing Early Cretaceous sea. This plant was included in a small collection of fossils from the base of the Lakota formation in Red Canyon, just west of the Minnekahta area renowned for its cycadeoid trunks. The Red Canyon collection failed to produce any cycadeoid foliage, and the specimens revealing anatomical details all belonged to *Sphenobaiera ikorfatensis* (Seward) Florin f. *papillata* Samylina. This species, at present, is known only from the lower Cretaceous of western Greenland and the upper Jurassic of Asiatic U.S.S.R.

Geologic Background. The discovery of uranium ores in the Lakota and overlying Fall River formations (Inyan Kara Group) has stimulated much interest in the stratigraphy of these complex terrestrial deposits. The recent revision of Black Hills, Upper Jurassic-Lower Cretaceous stratigraphy by Waagé (1959) divides the Inyan Kara Group into two formations. Of the names previously used, Waagé has retained Fall River formation for the upper strata (the sandy, marginal marine facies) above the transgressive disconformity, and Lakota formation for the more variable, more terrestrial rocks below the transgressive disconformity. According to Waagé this boundary zone, the disconformity, can be recognized by the distinctive banding which it commonly exhibits and also by the frequent occurrence of a zone of colorfully weathering, minute siderite pellets just below the disconformity (Waagé 1959, p. 52–56). Waagé regards this as a widespread weathering zone which was gradually encroached upon by the spread of the initial interior Cretaceous epeiric sea.

The Lakota formation attains its greatest thickness and variability in the southeastern Black Hills exposures. The presence in the Lakota of northwesterly trending channel fills and northwesterly dipping cross-bedding also points to a southeastern source for the sediments. The lower boundary of the Lakota is established on somewhat variable and local criteria.

[1] The author gratefully acknowledges the assistance of Dr. John W. Hall in the field work and in the investigation of the materials collected, the aid of Alex Simirenko in the Russian translation, and financial support during the collecting period by a Caroline M. Crosby Fellowship.

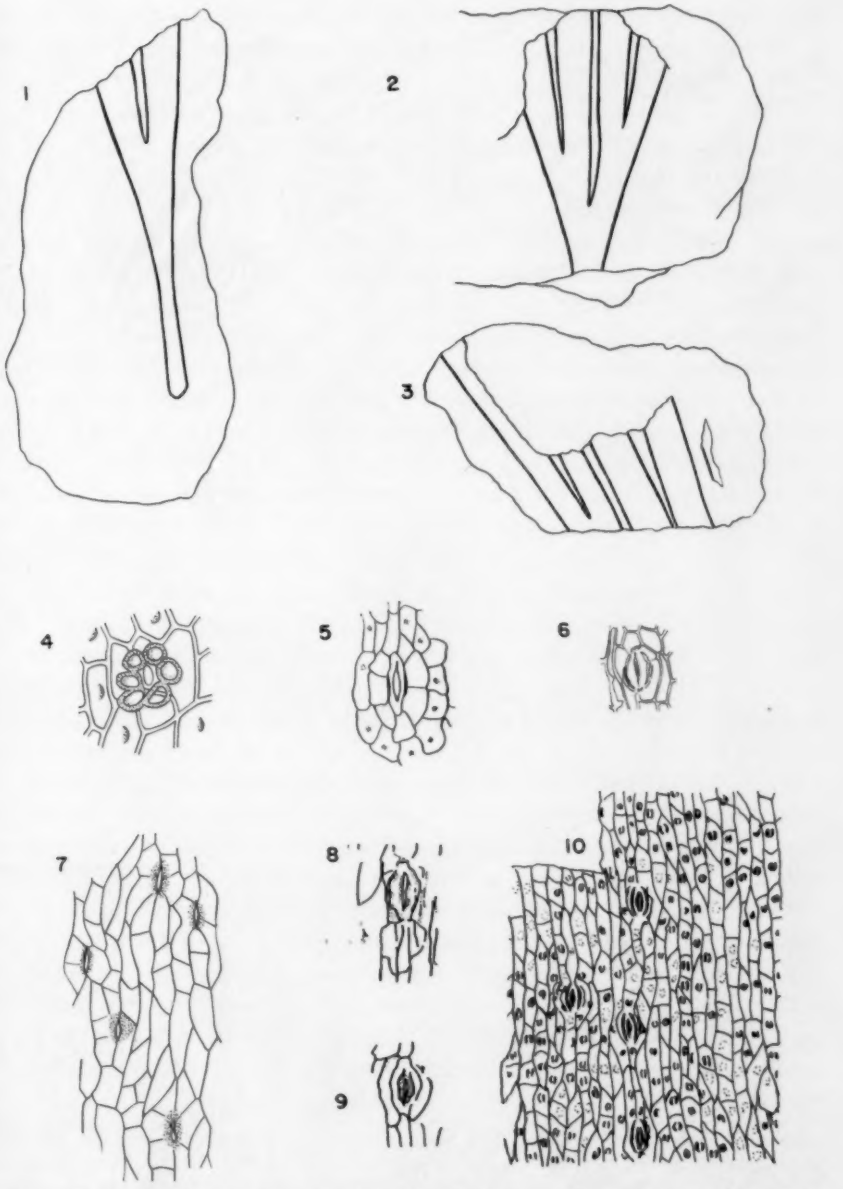
[THE BULLETIN for May–June 1960 (87: 173–245) was issued June 21, 1960.]

The underlying Morrison formation in much of the southern Black Hills is a characteristic greenish-gray claystone. The overlying beds may be massive brown-weathering sandstone (easily recognized as Lakota) or dark-gray to black locally carbonaceous shale and claystone which show a fairly sharp but apparently conformable contact with the greenish-gray Morrison claystone.

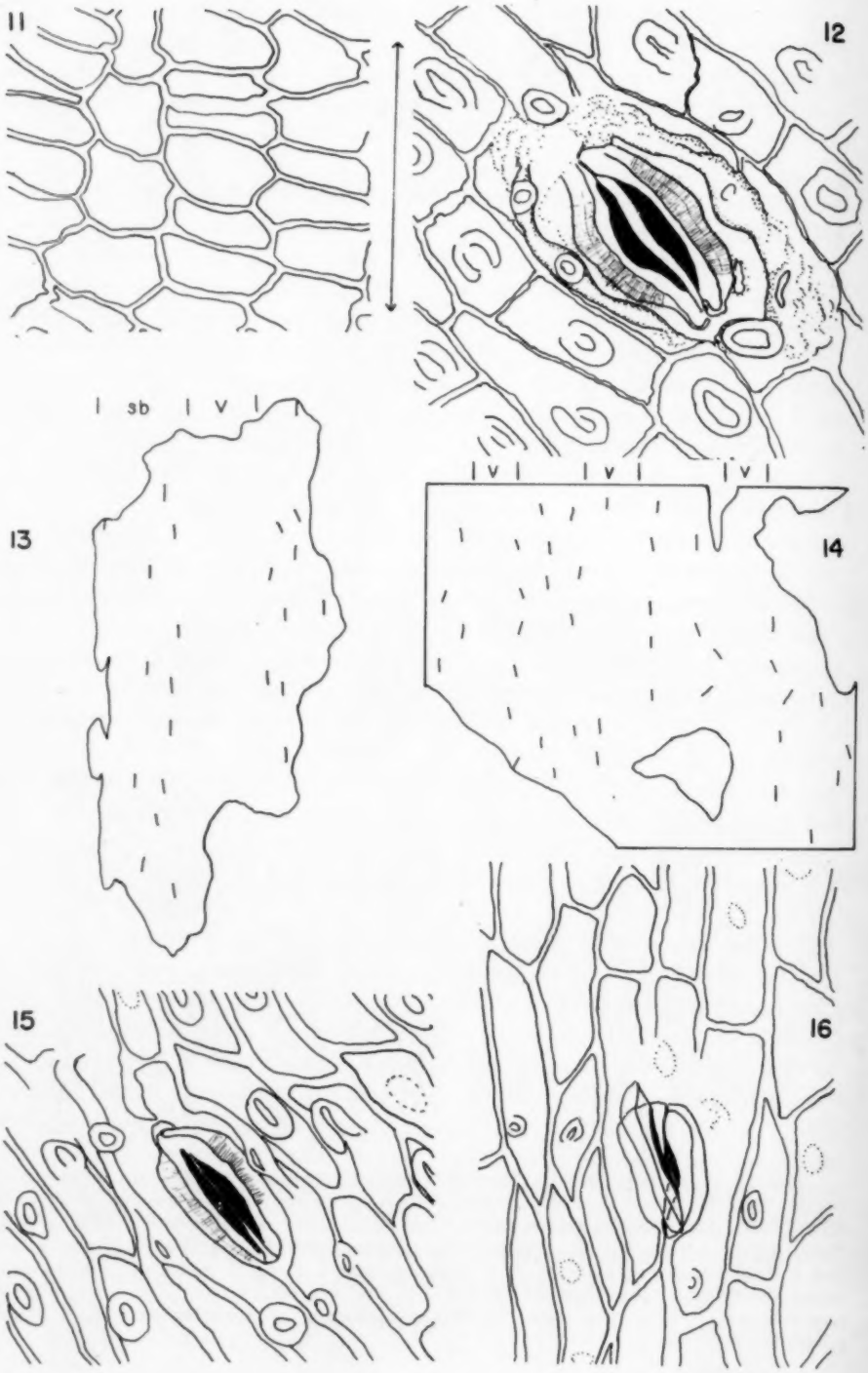
The Known Lakota Flora. The best known fossils from the Lakota formation are the extensive collections of cycadeoids from the Black Hills which have been described both morphologically and anatomically from well preserved silicified trunks (Ward *in* Ward et al 1899, Wieland, 1906, 1916). The cycadeoids were associated with extensive deposits of silicified gymnospermous wood identified by Knowlton (*in* Ward et al 1899, 1900) and Read (1932). According to Waagé's new division (p. 52) the cycadeoid beds are in the upper Lakota. The compression flora from the Inyan Kara group described by Fontaine (*in* Ward 1899) was collected by Jenney from the northern coal-bearing portion of the group outcropping in the area of Aladdin, Wyo. The lower Lakota of this area yielded fern, cycad, and conifer foliage in profusion, and also a few ginkgophyte leaves referred to *Czekanowskia nervosa* Heer. [Bell (1956) regards these specimens as conspecific with *Baiera furcata* (L. & H.) Braun.] Fontaine considered Jenney's flora early Cretaceous. Jenney's original subdivisions of the Inyan Kara strata of the Aladdin area have not been used subsequently by workers in the area. Angiosperm leaves are limited to the upper Fall River formation.

The Red Canyon Florule. Collections were made in August, 1959, by Dr. J. W. Hall, Mr. Delwin Cahoon, and myself, from the MIL Uranium Inc. Mine (NW¼, SW¼, sec. 20, R3E, T7S, Fall River Co., South Dakota). This is the basal rock unit of the Lakota formation, within a hundred feet of the Morrison contact. The impressions were found both in laminated gray siltstone and in medium-grained sandstone. Some specimens possessed well preserved leaf material.

The leaves were measured and sketched to scale. They were flooded with acetone and then one to several layers of nitrocellulose peel solution. Bubbles were pricked as they formed. After the coating had hardened overnight, the film was loosened from the rock with a razor blade and the leaf material lifted off the rock impression. Clinging clay particles were teased off the transfer under water. The leaf material was too opaque for immediate observation. Bleaching was necessary; from one half to ten hours in 5% aqueous sodium hypochlorite yielded sufficiently transparent specimens. To make them visible during handling and for observation, the leaves were stained with Safranin O. Patches of the exposed epidermis were freed with a delicate needle and were mounted in glycerine jelly. The other epidermis, still embedded in the transfer, was also mounted in glycerine jelly.



FIGS. 1–3. *Sphenobaiera ikorfatensis* f. *papillata* from the base of the Lakota formation, Red Canyon. ×1. FIG. 4. *Sphenobaiera spectabilis*, after Nathorst 1906, p. 8, fig. 6. ×150. FIG. 5. *Sphenobaiera ikorfatensis* f. *papillata*, after Samylina 1956, p. 538, Pl. 2, fig. b. ×160. FIG. 6. *Sphenobaiera pecten*, after Harris 1945, fig. 4B. ×125. FIG. 7. *Sphenobaiera spectabilis*, after Nathorst 1906, p. 7, fig. 3. ×125. FIG. 8. *Sphenobaiera ikorfatensis*, after Seward 1926, p. 95, text-fig. 11C. ×100. FIG. 9. As Fig. 8 except text-fig. 11D. ×100. FIG. 10. Upper epidermis of specimen in Fig. 3 above (slide 59-11a). ×85.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Description of the Florule. All the preparations which exhibited epidermal anatomy are referable to *Sphenobaiera*. The other fossils are identified only by their gross morphology.

1. Fern foliage. Fragments so poorly preserved that they cannot be identified. They resemble the following illustrations: *Thyrsopteris dentifolia* Fontaine (*in* Ward et al 1899 Pl. 161, fig. 6–9), *Gleichenia Zippei* (Corda) Heer (*in* Ward et al 1899 Pl. 162, fig. 9), *Coniopteris brevifolia* (Fontaine) Bell (1956 Pl. 1, fig. 2), *Cladophlebis parva* Fontaine (illustrated in Berry 1911, Pl. 30), *Anemia supercretacea* Hollick *conformis* Hollick (1930 Pl. 1, fig. 6).

2. *Sphenobaiera ikorfatensis* f. *papillata*. A ginkgophyte described below.

3. *Podozamites lanceolatus* (L. & H.) Braun. The Lakota specimens of this genus all fall within the range of this variable species as recognized by Sze (1931). The most similar illustrations of this puzzling conifer are those by Johansson (1922 Pl. 5, fig. 33, 34, Pl. 4, fig. 2–4) and Hollick (1930 Pl. 10, fig. 3a, Pl. 30, fig. 4a). Some of the broad (4–8 mm) parallel-veined leaves are attached to stems. One impression shows a stem bearing the basal portions of two leaves and a small spherical cone (5 mm long) .

4. Long, linear leaves. One fragment 43 mm long showed no taper. Width 1–2 mm. One broad median vein. One specimen shows four diverging leaves suggesting a fascicle. Similar to *Pinus susquaensis* Dawson (Ward et al 1899 Pl. 163, fig. 11a, 12, 13).

5. Winged Abietinean Seed. Wing 10 mm long. Outline resembles *Picea* among living plants.

6. Seeds of unknown affinities. Abundant, medium sized (about 11 mm × 9 mm × 6 mm), with a shriveled appearance. Under magnification most specimens show minute pits or papillae apparently in longitudinal rows.

Description of Sphenobaiera. (According to Florin 1936b.) Foliar leaves without a clearly differentiated stalk, narrowed to wedge-shape toward the base and more or less narrowly triangular or strap-shaped to almost linear in their outline. Foliar leaves always more or less deeply divided into lobes which almost always include more than four veins in their width. Type: *Sphenobaiera spectabilis* (Nathorst) Florin in Nathorst (1906).

Sphenobaiera ikorfatensis (Seward) Florin f. *papillata* Samylina. Composite description based on the Lakota specimens (fig. 1–3). Narrowly

FIG. 11. Epidermal cells of stalk of specimen in Fig. 1 (slide 59-4a). Arrow indicates the long axis of the leaf. × 420. FIG. 12. Stomatal apparatus from the upper surface of the lamina of the specimen in Fig. 3 (slide 59-11b). ×420. FIG. 13. Stomatal distribution pattern of a portion of the upper epidermis from specimen in Fig. 3 (slide 59-11a). v = vein, s.b. = stomatal band. ×32. FIG. 14. Stomatal distribution pattern of a portion of the lower epidermis from specimen in Fig. 3 (slide 59-15). v = vein. ×32. FIG. 15. Stomatal apparatus from the upper surface of the lamina of the specimen in Fig. 2 (slide 59-5). × 420. FIG. 16. Stomatal apparatus from lamina of specimen in Fig. 1 (slide 59-7). ×420.

wedge-shaped leaves, divided dichotomously into 2 or 4 long, strap-shaped lobes. Lateral margins of the lamina converge toward the base at an angle of 20 to 30 degrees. Leaf is terminated basally by a short, poorly demarcated stalk which is slightly expanded at the point of attachment. Minimum stalk diameter is 2 mm. Lobes 3.5 to 6 mm broad. Veins are more or less parallel and spaced about 0.6 mm apart (6–13 across a lobe). No resin bodies were observed.

The cuticle is durable and relatively thick. Stomata are abundant on both leaf surfaces although there is a tendency toward a slightly smaller number and more regular arrangement on one surface, which will be called the upper epidermis. Regular stomatal bands, separated by rows of elongate cells over the veins, are characteristic of the upper epidermis (fig. 13). On the lower leaf surface, stomata encroach upon the veins (fig. 14). On both surfaces the stomata are longitudinally oriented and show some tendency to occur in rows (figs. 10, 13, 14).

Epidermal cells of the lamina are elongate to polygonal and form longitudinal rows (fig. 10). Trichomes are absent but almost every cell has a centrally located papilla or a raised, thickened area of cuticle. The epidermis of the stalk of the specimen in fig. 2 is a continuous layer of small, rectangular cells, lacking papillae and having their long axes perpendicular to the long axis of the stalk (fig. 11). The lamina of this specimen has the typical stomatal pattern (fig. 16). Guard cells are relatively large and are exposed. Guard cell walls are thickened near the aperture and on the lateral walls but are thin at the poles. Subsidiary cells are irregular—the lateral ones often elongated, and terminal ones often apparently absent. The exact description of the neighboring cells is hampered by the frequent buckling of the outer walls of the subsidiary cells and the neighboring cells to form an encircling ridge (fig. 12). This ridge only rarely overlaps a guard cell. The thin surface wall of the subsidiary cells makes the stomatal apparatus easily visible among the thicker walled epidermal cells. The only strongly thickened wall of the lateral subsidiary cell is the one adjacent to the guard cell (figs. 12, 15, 16).

The preceding description of the Lakota specimens differs in a few respects from the descriptions given by Seward (1926) and Samylina (1956).

1. f. *papillata* Samylina is described as possessing a ring of 6–8 subsidiary cells (fig. 5). Seward describes the subsidiary cells as long and narrow cells, one on each side of the stoma and each occasionally divided by one or two transverse walls. The typical condition is illustrated in figs. 8 and 9. The Lakota leaves exhibit the latter condition.

2. f. *papillata* Samylina has significantly smaller numbers of stomata on the upper leaf surface. Seward does not mention the distribution of the

stomata. The Lakota leaves have only a slightly smaller number of stomata on the "upper" surface.

3. The Lakota leaves are slightly smaller than those illustrated by Seward and Samylina (figs. 19 and 18).

4. The angle of convergence of the lateral margins is given by Samylina as 45°–50°. Seward's illustration shows an angle of 25°–30°. The Lakota specimens have a basal angle of 20°–30°.

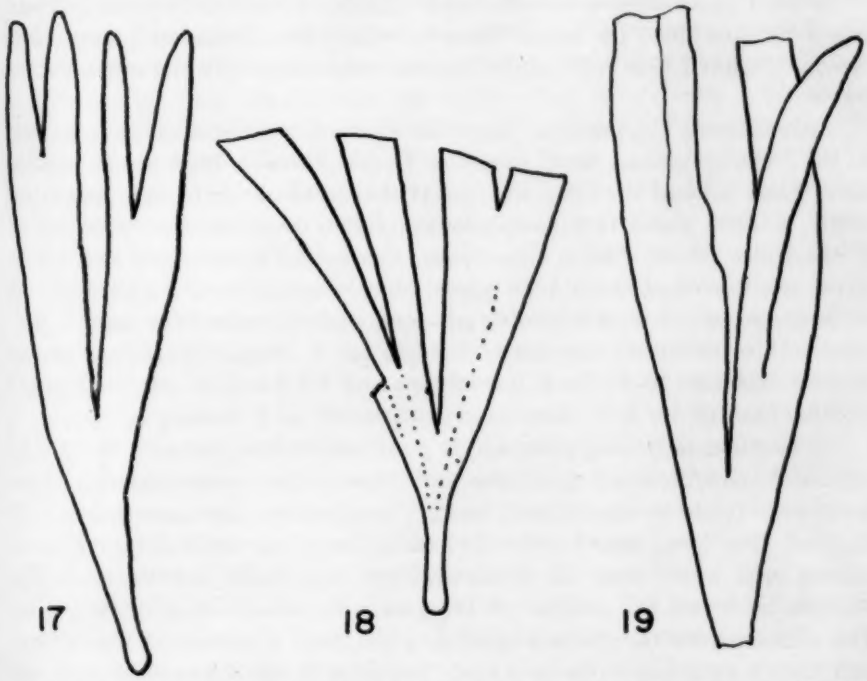

FIG. 17. *Sphenobaiera spectabilis*, after Harris 1926, p. 100, fig. 23A. ×1. FIG. 18. *Sphenobaiera ikorfatensis f. papillata*, after Samylina 1956, Pl. 3, fig. 2. ×1. FIG. 19. *Sphenobaiera ikorfatensis*, after Seward 1926, Pl. 9, fig. 81. ×1.

5. The size of the guard cells appears to be smaller and more variable in the Lakota leaves than indicated by the other descriptions: Seward (79 × 29 μ), Samylina (70 × 30 μ), Lakota specimens (from 38 × 26 μ to 66 × 21 μ with an average of 52 × 24 μ within a sample of 30 pairs of guard cells).

These minor divergences may be attributed to the variability of the species. The many similarities far outweigh these discrepancies. Seward's and Samylina's descriptions are included here to emphasize the similarities.

Baiera ikorfatensis Seward (1926, figs. 8, 9, 19): "When slightly magnified the lamina is seen to have relatively prominent veins (not shown in the drawing) about 0.7 mm apart, and more slender longitudinal striations

between the veins; there is also a fine transverse wrinkling as in many Ginkgoalean leaves.

"The epidermal cells are elongated and the walls are straight; stomata occur between the veins. The stomata (79 $\mu \times 29$ μ) have truncated ends, and there are indications of a thickened strip parallel to the pore. A long and narrow cell lies on each side of the stoma, and occasionally this is divided by one or two transverse walls." Papillae are lacking.

Seward's specimens were collected at Ikorfat in western Greenland, from strata 800 feet above the beach. These beds have been considered lower Cretaceous (Seward 1926). *Pityophyllum* was associated with the ginkgophyte leaves.

Sphenobaiera ikorfatensis (Seward) Florin f. *papillata* Samylina (figs. 5, 18): The specimens were found in Upper Jurassic beds of the Aldan River bank beyond the settlement of Djebariki-khaia (Siberia). Samylina (1956, p. 539) states that morphologically they resemble the examples of *S. longifolia* (Heer) Florin from Lower Cretaceous strata along the Aldan River also described in the 1956 paper. Morphologic differences pointed out by Samylina are: 1. *S. ikorfatensis* possesses slightly wider lobes than *S. longifolia* (7 to 12 mm in contrast to 5–9 mm for *S. longifolia*), 2. number of veins in each lobe 10–12 for *S. ikorfatensis* and 4–7 for *S. longifolia*, 3. angle of blade base 45–50° in *S. ikorfatensis* and 25–30° in *S. longifolia*.

In contrast to *S. longifolia* which possessed sunken stomata, the guard cells of *S. ikorfatensis* f. *papillata* were exposed and easily observed. Stomata were found in significantly smaller numbers on the upper surface of the leaf. The large guard cells (70×30 μ) were surrounded by 6–8 subsidiary cells which were not much different from other nearby cells. The stomata lie between a number of elongate cells associated with the veins. The cells between the stomata are polygonal, bear a papilla in the center, and have a tendency to be in a row. The cells of the lower epidermis are somewhat elongate in the long direction of the leaf. Samylina establishes the form *papillata* to accommodate these leaves which are excluded by Seward's description of the Ikorfat specimens. The exposed stomata of this species are considered an adaptation to a relatively humid climate.

One species with a somewhat similar leaf form is *S. spectabilis* (Nathorst) Florin, widely distributed in the arctic. Harris's studies of Rhaetic and Jurassic plants (1926, 1935) of eastern Greeland illustrate great morphologic variability in this species. The expanded leaf base shown by fig. 17 (Harris 1926, p. 101) is like that of fig. 1 even to the shape of the epidermal cells. Other similarities of *S. ikorfatensis* and *S. spectabilis* are the elongate, longitudinally oriented guard cells (fig. 7), the abundance of stomata on both leaf surfaces, the absence of stomata over the veins. The presence of a prominent ring of papillae overhanging the guard cells is the most striking

difference between the cuticles of the two species (fig. 4 vs. fig. 8). The epidermis of *Sphenobaiera spectabilis* was redescribed and illustrated by Florin (1936, p. 39), when he used this as the type species of the genus.

There is a striking resemblance between the stomata of *Sphenobaiera pecten* Harris (1945) and those of Lakota specimens (fig. 6). However, the leaves of this Yorkshire Jurassic species are much smaller and more extensively forked than *S. ikorfatensis*.

The cuticle of the Lakota specimens of *Czekanowskia nervosa* Heer [*Baiera furcata* (L&H) Schimper] has not been described; however, the cuticle of some Yorkshire specimens of *B. furcata* described by Harris (1945, p. 216) does not resemble the cuticle of *S. ikorfatensis* f. *papillata*.

Among North American species of *Sphenobaiera*, few resemble the Lakota specimens. *S. multifida* (Fontaine) Florin (see Fontaine 1883), from the older Mesozoic flora of Virginia, has a distinctly different manner of forking, a much wider basal portion, and is probably always larger. *S. foliosa* (Fontaine) Florin (see Fontaine 1889), from the Patuxent of the Atlantic Coast, is much smaller and more delicate than the Lakota specimens. Dawson's fragment of *S. longifolia* (Heer) Florin from the Canadian Kootenay (1886, p. 9, Pl. 2, fig. 5) is more delicate than the Lakota specimens but is the most similar North American fossil. However, the cuticle of *S. longifolia* described by Thomas (1913, p. 243) and by Samylina (1956, p. 538) differs most strikingly from *S. ikorfatensis* in the possession of a ring of prominent papillae protruding over each stoma. Seward (1926, p. 96) points out the morphologic similarity of *S. ikorfatensis* and the specimens from the Cape Lisburne, Alaska Jurassic which Knowlton (1914, p. 52) described and illustrated as *Phoenicopsis speciosa* Heer.

Geologic Age. The few species available in the Red Canyon florule do not permit an accurate evaluation of its geologic age. *Sphenobaiera ikorfatensis* is known from the Upper Jurassic and the Lower Cretaceous. *Podozamites lanceolatus* (L&H) Braun is a long-ranging Mesozoic species. Hollick (1930, p. 7) found abundant representatives of the latter species along the Yukon River in the lower part of the Upper Cretaceous strata. He points out that the species is only sparingly represented in other Cretaceous floras. *Podozamites lanceolatus* occurs in the Cenomanian of Bohemia, the Raritan of eastern U.S., and the Dakota Group of Kansas. According to Hollick it is most frequently found in Jurassic floras of western U.S., northern Siberia, and Spitzbergen. It is frequently found in floras which also have Bennettitalean foliage.

The information contributed by the Red Canyon florule could be considered to support the previous dating of the Lakota as Lower Cretaceous. It could also support an Upper Jurassic date for this lowest unit of the Lakota formation.

SUMMARY

Plant fossils from the basal rock unit of the Lakota formation of the Black Hills which Fontaine considered to be of Lower Cretaceous age were examined for epidermal structure. Only one species was found to possess a well preserved epidermis. On the basis of gross morphology and epidermal anatomy it was identified as *Sphenobaiera ikorfatensis* (Seward) Florin f. *papillata* Samylina. Previously, this ginkgophyte was known only from the Lower Cretaceous of Western Greenland and the Upper Jurassic of Asiatic U.S.S.R.

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Literature Cited

Bell, W. A. 1956. Lower Cretaceous Floras of Western Canada. Geol. Surv. of Canada, Mem. 285.

Berry, E. W. 1911. in Maryland Geol. Surv. Lower Cretaceous.

Dawson, J. W. 1886. On the Mesozoic Floras of the Rocky Mountain Region of Canada. Trans. Roy. Soc. Canada 1885. **3**, Sec. **4**: 1–22.

Florin, R. 1936a. Die fossilen Ginkgophyten von Franz-Joseph Land. I. Spezieller Tiel. Palaeontographica, **81B**: 71–173.

———. 1936b. Ibid. II. Allgemeiner Tiel. Ibid. **82B**: 1–72.

Fontaine, W. M. 1883. Contributions to the knowledge of the Older Mesozoic flora of Virginia. U. S. Geol. Surv. Mon. 6.

———. 1889. The Potomac or Younger Mesozoic Flora. U. S. Geol. Surv. Mon. 15.

Harris, T. M. 1926. The Rhaetic flora of Scoresby Sound, East Greenland. Medd. om Grønland **68**: 43–148.

———. 1935. The fossil flora of Scoresby Sound, East Greenland, Part 4: Ginkgoales, Coniferales, Lycopodiales, and isolated fructifications. Medd. om Grønland **112**: 1–176.

———. 1945. Notes on the Jurassic Flora of Yorkshire, 16–18. Ann. & Mag. Nat. Hist. Ser. 11, **12**: 213–234.

Hollick, A. 1930. The Upper Cretaceous Floras of Alaska. U. S. Geol. Surv. Prof. Paper 159.

Johansson, N. 1922. Die rätische Flora der Kohlengruben bie Stabbarp und Skromberga in Schonen. K. Svenska Vet. Akad. Handl. **63**, No. 5.

Knowlton, F. H. 1900. In Ward's Status of the Mesozoic floras. 20th Ann. Rept. U. S. Geol. Surv. pt. 5: 419–422.

———. 1914. The Jurassic flora of Cape Lisburne, Alaska. U. S. Geol. Surv. Prof. Paper 85.

Nathorst, A. G. 1906. Om Några Ginkgoväxter från Kolgrufvorna vid Stabbarp i Skåne. Lunds Univ. Årssk. N. F. Afd. **2**, Bd. 2, No. 8.

Read, C. B. 1932. *Pinoxylon dakotense* Knowlton from the Cretaceous of the Black Hills. Bot. Gaz. **93**: 173–187.

Samylina, V. A. 1956. Epidermal structure of leaves within the Genus *Sphenobaiera*. (in Russian) Dokl. Akad. Nauk., S.S.S.R. **106**: 537–539.

Seward, A. C. 1926. On the Cretaceous plant-bearing rocks of western Greenland. Phil. Trans. Roy. Soc. London ser. B **215**: 57–175.

Sze, H. C. 1931. Beiträge zur Liasischen Flora von China. Acad. Sinica, Inst. of Geol. Mem. 12.

Thomas, H. H. 1913. The fossil flora of the Cleveland district. Quart. Journ. Geol. Soc. **69**: 223–251.

Waagé, K. M. 1959. Stratigraphy of the Inyan Kara Group in the Black Hills. U. S. Geol. Surv. Bull. 1081-B.

Ward, L. F. & W. P. Jenney, W. M. Fontaine, F. H. Knowlton. 1899. The Cretaceous formations of the Black Hills as indicated by the fossil plants. U. S. Geol. Surv. Ann. Rept. 19, pt. 2: 521–946.

Wieland, G R. 1906. American Fossil Cycads, **1**, Structure. 1916 **2**, Taxonomy. Carnegie Inst. Wash. Pub. 34.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 87, No. 4, pp. 258–270 JULY, 1960

A LATE-GLACIAL POLLEN DIAGRAM FROM TAUNTON, MASSACHUSETTS

MARGARET B. DAVIS

Introduction. Recent investigations of pollen-bearing deposits in southern New England have increased our understanding of vegetational history following the retreat of the Wisconsin ice sheet. Pollen sequences deposited during the Two Creeks interval and Valders time have been studied from southern Connecticut (Leopold, 1955, 1956), central and eastern Massachusetts (Davis, 1958, 1960b) and Martha's Vineyard (Ogden, 1959). In addition, pollen sequences thought to have been deposited prior to the Two Creeks interval have been described from sediments at Totoket, Connecticut (Leopold, 1955, 1956) and Martha's Vineyard (Ogden, 1959). The purpose of investigating late-glacial sediments at Taunton, in southeastern Massachusetts (Fig. 1), was to study possible geographical variations in the Two Creeks-Valders pollen sequence, and to explore the possibility that the pollen

FIG. 1. Sketch map of New England, showing locations of late-glacial sites discussed in text.

profile would include a sequence similar to pre-Two Creeks sequences reported from other localities.

Evidence that the sediments at Taunton are contaminated with pollen rebedded from pre-Quaternary deposits was obtained during the course of the analysis. The problems of estimating the extent of such contamination and of interpreting pollen analyses of contaminated sediments are discussed elsewhere (Davis, 1960a). In the present paper the pollen diagram from the uncontaminated portion of the sediment profile will be described and compared with other diagrams, and the possible stratigraphic significance of the pollen sequence will be discussed.

Acknowledgments. I am indebted to the following for their helpful suggestions and critical review of an earlier version of the manuscript: J. H. Hartshorn, J. P. Schafer, J. C. Goodlett, D. A. Livingstone, and E. B. Leopold. This work was done at the Biology Department, Harvard University, and the Geology Division, California Institute of Technology, and was supported by NSF fellowships 47035 and 40002, and NSF research grant (to E. S. Deevey) G-4802. This paper is Contribution 980 from the Geology Division, California Institute of Technology.

Methods and Results. Samples were collected from a bog located in the southern part of the Taunton quadrangle, between Williams Street and the Taunton river, near the Taunton Water Works (71°04′W, 41°54′N). The bog is unnamed on the U. S. Geological Survey topographic sheet, and is referred to here as the Williams St. bog. It is about 350 m in diameter, and now supports a vegetation of sphagnum moss, brush and small trees. The surface lies between 10 and 20 ft. above sea level. The depression which the bog occupies is a kettlehole in glacial drift, bordered by an esker and by kame or lake deposits. Samples were collected with a Hiller borer in November, 1957, and peat and sediment types were identified in the field. The profile is as follows:

0–2.77 m brown peat with wood and moss fragments
2.77–2.86 m coarse fibrous peat with grass-like leaf fragments
2.86–3.43 m very fine fibrous peat
3.43–3.62 m very fine fibrous peat grading to gyttja
3.62–4.00 m gray green gyttja
4.00–4.41 m green brown gyttja
4.41–4.47 m fibrous peat with grass-like leaf fragments
4.47–4.95 m gray silty sand streaked with dark gray sand, sandy layer at 4.80 m
4.95–5.20 m medium coarse sand. Deposits below this level could not be penetrated with the Hiller borer

Percentage weight loss on ignition was determined by desiccating small (50–700 mg) samples at 100°C for 24 hr. and igniting them in a 500°C

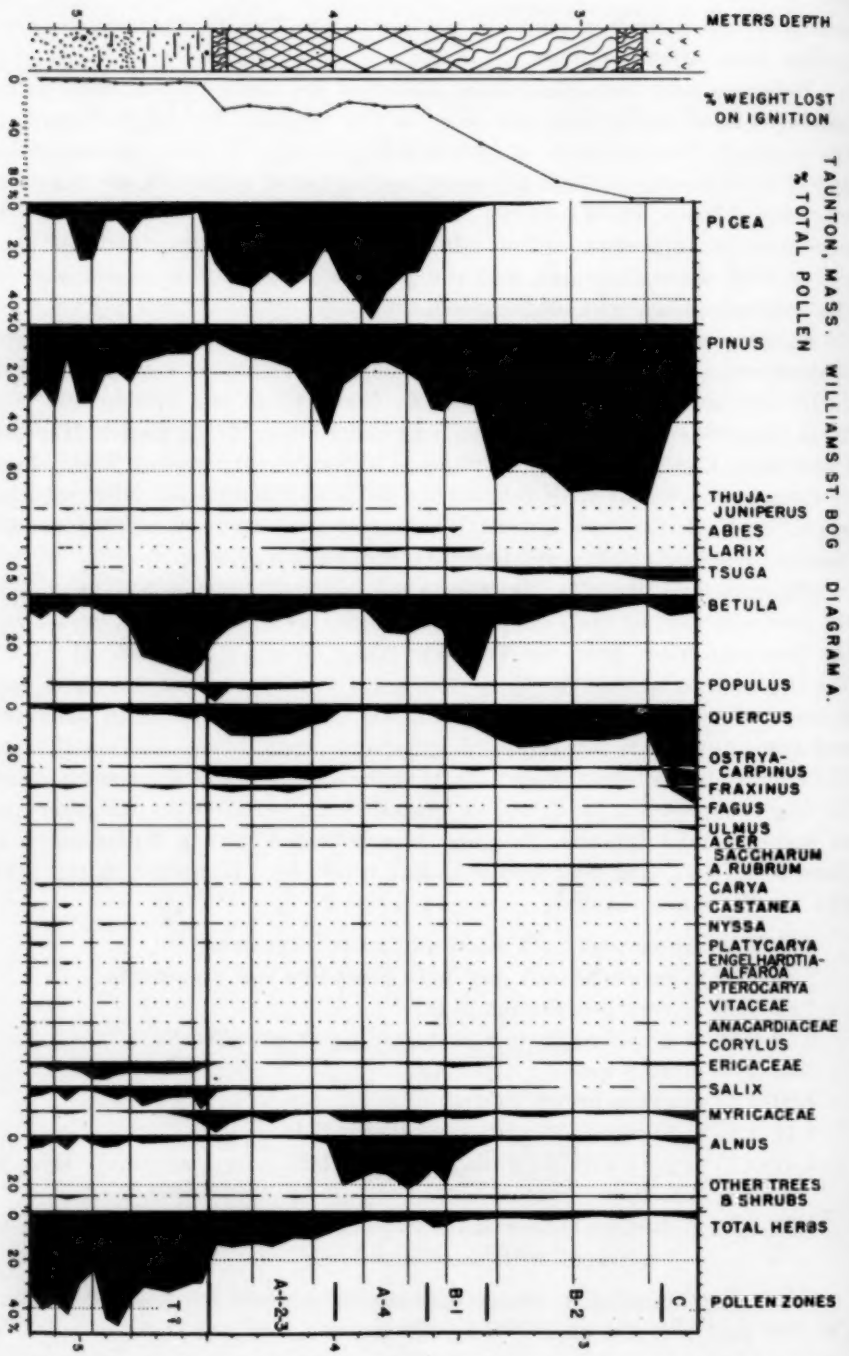

FIG. 2. Pollen diagram from Williams St. bog, Taunton: Diagram A, tree and shrub pollen percentages.

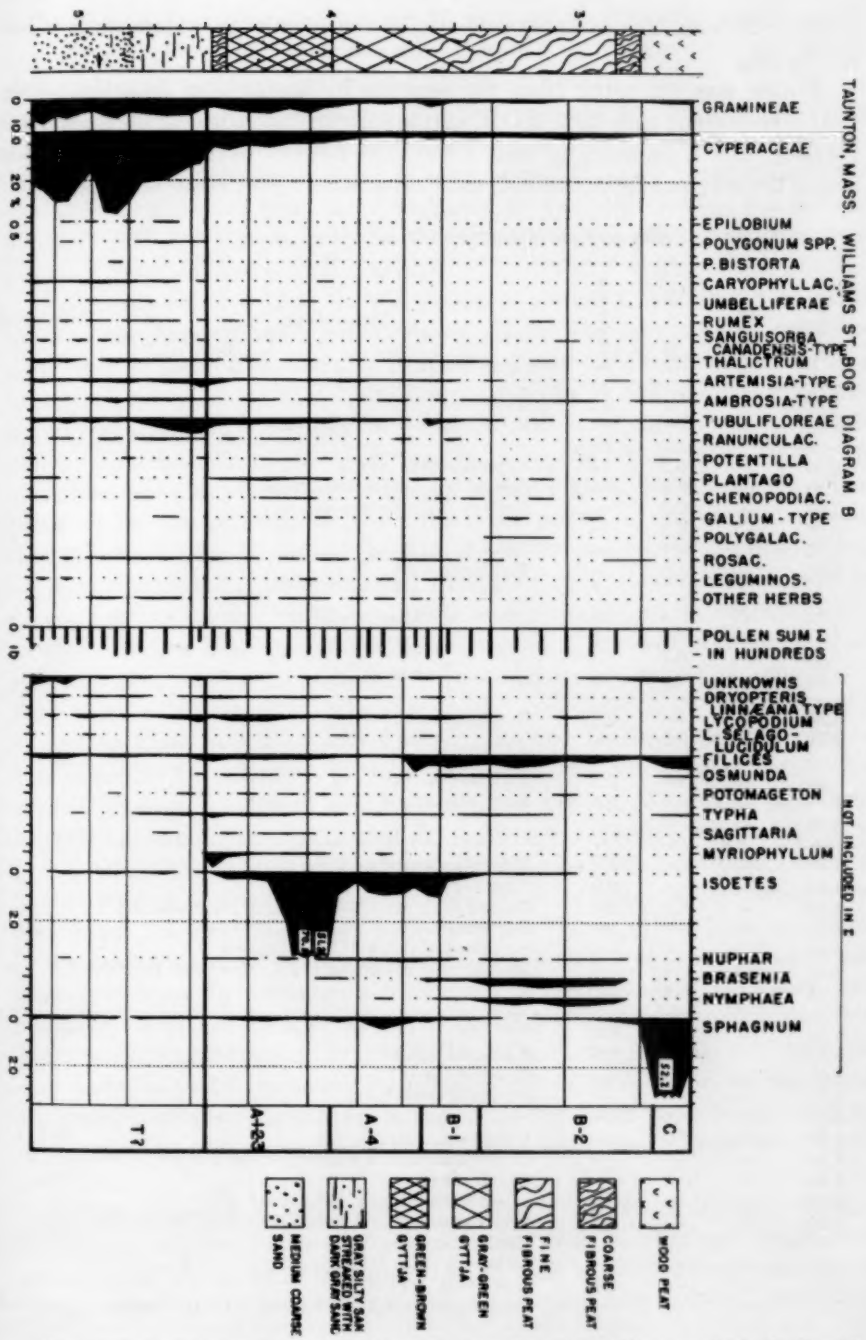

FIG. 3. Pollen diagram from Williams St. bog, Taunton: Diagram B, herb, Pteridophyte and aquatic plant pollen percentages.

oven for 25 min. The samples were cooled for 15 min. in a desiccator before reweighing.

Pollen was extracted from the samples by bromoform flotation (Frey, 1951), treatment with 10% KOH, and acetolysis (modified from Faegri and Iversen, 1950). Samples of peat from 2.55–2.85 m were passed through a coarse brass screen before acetolysis. Preparations were stained and mounted

TABLE 1. *Pollen and spore percentages not shown on the pollen diagram.*

Depth	*Juglans*	*Ilex*	*Viburnum*	Percentage	Pollen zone
2.55 m	—	—	0.2	*Tilia* 0.2	C
2.65	—	—	—	*Tilia* 0.3; *Celtis?* 0.1; *Clethra* 0.1	
2.75	—	0.3	—	*Cephalanthus* 0.1	
2.85	0.1	0.4	—	*Celtis?* 0.1; *Liliaceae* 0.1	
2.95	—	0.2	—	*Cornus* 0.1; *Eriocaulon* 0.1	
3.05	0.1	0.2	—		B-2
3.15	0.1	0.7	—	*Liliaceae* 0.2	
3.25	—	1.0	—	*Equisetum* 0.1	
3.42	0.2	0.4	0.1		
3.52	—	0.4	0.2		B-1
3.55	—	0.2	0.1		
3.60	—	0.2	0.1	*Acer spicatum* 0.2	
3.65	—	—	0.1	Saxifragaceae? 0.1	
3.70	—	0.1	—		
3.78	0.1	—	—	*Equisetum* 0.1	A-4
3.84	—	—	0.2	*Equisetum* 0.1	
3.88	—	—	0.1	Saxifragaceae? 0.1	
3.96	—	—	—		
4.02	—	—	—	*Cephalanthus* 0.1	
4.08	—	—	0.3	*Xanthium* 0.1	
4.16	—	0.1	0.2	*Celtis?* 0.1; cf. *Lechea* 0.1; *Urticaceae* 0.1	
4.24	—	—	—	*Hippuris?* 0.1	A-1-2-3
4.32	0.1	—	—	Scrophulariaceae 0.1; *Hippuris* 0.1	
4.40	0.1	—	—	*Shepherdia canadensis* 0.1; *Linnaea borealis* 0.1	
4.46	—	0.1	0.1		
4.52	—	—	—		
4.55	—	—	0.1	*Equisetum* 0.2	
4.65	—	—	—	*Campanula* 0.1	
4.75	—	—	—	Saxifragaceae? 0.1	
4.80	0.1	0.1	—		
4.85	—	—	—	Unknown, type I 0.1	T ?
4.90	—	—	—	Cruciferae 0.1; Unknown, type I 0.1	
4.95	—	0.1	—	Cruciferae 0.1	
5.00	—	—	0.2	*Liquidambar* 0.2; Liliaceae? 0.2	
5.05	0.2	—	0.7	*Symplocos* 0.2; *Cephalanthus* 0.3; *Equisetum* 0.2; Unknown, type I 0.3	
5.10	—	—	—	Liliaceae 0.2; Unknown, type I 0.9	
5.15	—	—	0.4	Unknown, type I 0.4	
5.20	—	—	—	Cephalanthus 0.3; Liliaceae 0.1; Unknown, type I 0.1	

in Tanglefoot mounting medium #8. In each sample 500–1200 pollen grains were counted. Percentage values were calculated as percent total pollen, excluding spores, unknown pollen and pollen of water plants.

The pollen sequence (Figs. 2 and 3 and Table 1) has been divided into pollen zones, each of which is characterized by higher percentages of one or several pollen types than occur in other zones. The zone boundaries, some of which are modified from those proposed by Leopold (1955), are defined by characteristic changes in pollen frequencies that appear in all diagrams available from southern New England.

Sediments below 4.52 m contain pollen of genera which do not occur in the modern flora of the United States. *Platycarya* and *Pterocarya* now occur only in Asia, *Engelhardtia* in Asia and central America, and *Alfaroa* in central America. As these genera do not occur in the modern flora and are not found in the postglacial fossil record, it is concluded that their pollen is derived from pre-Quaternary sediments which were eroded by glacial ice and redeposited in the bog sediments (Davis, 1960a). Other pollen types which are indistinguishable from the pollen of late-glacial species may also have been deposited secondarily in the sediments. Because it has not been possible to determine the extent of such contamination, nor to subtract the secondary pollen spectrum, vegetational interpretations of the sediments below 4.52 m will not be attempted. The stratigraphic position indicates that these sediments may correspond in age to pollen zone T (or T-3) at other sites.

Pollen Zone A-1-2-3 (3.98–4.46 m), Lower Durham Spruce zone.— This zone is characterized by high percentages of tree pollen relative to herb pollen. In the lowest sample (4.46 m) poplar (*Populus*) and birch (*Betula*) pollen are relatively abundant. Above this level, the spruce (*Picea*) pollen percentage is 30%, oak (*Quercus*) 12%; and hop-hornbeam (*Ostrya*) or ironwood (*Carpinus*), ash (*Fraxinus*), beech (*Fagus*), sugar maple (*Acer saccharum*), balsam fir (*Abies balsamea*) and larch (*Larix*) pollen occurs in low percentages. At 4.02 m deciduous tree pollen frequencies decline and pine (*Pinus*) pollen reaches a maximum of about 45%. The upper zone boundary is placed at 3.98 m, at the decline of deciduous tree pollen and just above the maximum of pine pollen. The lower boundary of the zone may correspond to the lower zone boundary at other sites, as the pollen spectrum at this level is similar to pollen spectra from the lower part of the spruce zone at Petersham and Athol (Davis, 1958) and Cambridge (Davis, 1960b).

Pollen Zone A-4 (3.62–3.98 m), Upper Durham Spruce Zone.— Percentages of deciduous tree pollen (other than birch) and *Thuja-Juniperus* pollen are lower in this zone than in zone A-1-2-3. Spruce pollen percentages are high (30–45% total pollen, 40–60% tree pollen), and birch,

Myricaceae and alder (*Alnus*) pollen are abundant. Fir, larch and hemlock (*Tsuga*) pollen occur in low frequencies. The upper boundary of zone A-4 is placed at 3.62 m, as spruce pollen percentages decrease and pine and oak pollen percentages increase.

Pollen Zone B-1 (3.38–3.62 m), Lower Pine Zone.—This zone is characterized by high pine, birch, fir and larch pollen percentages. Deciduous tree pollen percentages are slightly higher than in the underlying zone, and red maple (*Acer rubrum*) appears in the spectrum for the first time. The upper boundary of zone B-1 is placed at 3.40 m, at the fall of birch and rise of oak pollen percentages.

Pollen Zone B-2 (2.70–3.38 m); Upper Pine Zone.—Percentages of pine and oak pollen are higher in the upper pine zone than in zone B-1. Hemlock, red maple, sugar maple and other deciduous tree pollen types also occur in higher percentages. The upper boundary of the zone is placed at 2.70 m. Pine pollen percentages are much lower above this level, and oak pollen percentages increase to over 40%. The pollen zone represented by the two samples above 2.70 m is designated zone C, because of the predominance of deciduous tree pollen (Deevey, 1939). Additional analyses of the wood peat were not done because of poor pollen preservation in the samples, and the possibility that bog species growing directly over the site of deposition might be overrepresented in the pollen spectrum.

Discussion. Several sources of error make interpretation of the pollen diagram difficult. First is the occurrence of secondary pollen in the lower sediments (Davis, 1960a). Although there is no conclusive evidence of contamination above 4.52 m (pollen of exotic genera was not found) small amounts of secondary pollen may be present. Vegetational interpretations are therefore based on the major constituents of the pollen spectrum, and are confined to the sediments and peat above 4.52 m. A second difficulty arises from our lack of knowledge of the relative efficiency of plant species in the production and dispersal of pollen. A comparison of the present vegetation and the pollen in recent lake sediments in northern Vermont (Davis and Goodlett, 1960) illustrates the difficulties in attempting vegetational interpretations of pollen diagrams. Davis' and Goodlett's data on relative representation of forest tree genera in pollen spectra can be applied only tentatively to the sediments at Taunton, as geographical variations in pollen production have not been tested for. Furthermore, because species within the same genus may vary in pollen production, data based on the species now present in northern Vermont may not necessarily apply to the species that contributed pollen to sediments at Taunton in late-glacial time. An additional source of error is the possible overrepresentation of pollen from shore vegetation. The Williams St. bog is now 350 m in diameter; at the time of deposition of limnic sediments shore vegetation may have grown

very near the site where the pollen samples were taken. There are no pollen diagrams from the vicinity with which the sequence may be compared, and it may be difficult to distinguish between evidence of local and regional vegetational changes. Because of these three sources of error, it is possible only to interpret tentatively some of the major features of the changes in the pollen flora.

High percentages of tree pollen relative to herb pollen in the Lower Durham Spruce zone (A-1-2-3) appear to indicate forest vegetation. However, herb pollen comprises 10% of the pollen sum in all the samples from this zone, perhaps implying discontinuous forest, or forest growing some distance from Taunton. A more definite interpretation cannot be made because the efficiency of pollen dissemination of herbaceous vegetation relative to spruce, which is the dominant tree pollen type, is not known. Possibly, some of the nonarboreal pollen at this site may have come from local shore vegetation.

Poplar pollen percentages are maximal in the lowermost part of the Lower Durham Spruce zone. At Petersham and Athol there is an even stronger maximum of poplar pollen in the lower spruce zone (A-1), which at these sites is underlain by sediments with a maximum of herb pollen (T-3) and overlain by sediments with a maximum of spruce pollen (A-2). This sequence was thought to represent a succession from open vegetation to poplar forest to spruce forest (Davis, 1958). The writer now feels that this interpretation may be incorrect, and that the pollen sequence may indicate a constant number of poplar trees during the deposition of A-1 and A-2 sediments. This interpretation is possible because an increase in the number of spruce trees during the deposition of A-2 sediments might have resulted in a decrease in the relative frequency of poplar pollen, as the poplar species in northern Vermont appear to be poor pollen producers relative to spruce (Davis and Goodlett, 1960). At Taunton, lower percentages of poplar pollen (8% compared to 20% at Petersham and Athol) may have resulted from the simultaneous arrival (within pollen dissemination distance) of tree genera with comparatively high pollen production.

It is impossible to determine whether all the tree pollen types that occur in the Lower Durham Spruce zone represent species that were growing within the Taunton quadrangle. Although Davis' and Goodlett's data indicate that arbor vitae (*Thuja occidentalis*), fir, larch, poplar and sugar maple are poor pollen producers relative to other genera represented in this zone, the distances to which pollen of these species may be dispersed is not known. These authors' data also indicate that red and white pine (*P. resinosa* and *P. strobus*) and red oak (*Q. rubra*) are prolific pollen producers relative to the spruce species in northern Vermont. Oak and pine pollen in the Durham Spruce zone at Taunton may have come from a few trees

nearby, or from large populations of these genera growing at some distance. The pine pollen maximum along the border between zones A-1-2-3 and A-4 may represent only a minor vegetational change because of the high pollen production of this genus relative to spruce. Davis (1958) has discussed the possibility that the deciduous tree pollen maxima in zone A-3 at Petersham and Athol are the result of increased solifluction and the resulting deposition of secondary pollen. This is not the case at Taunton, as no pollen of exotic genera was found in the spruce zone to indicate the presence of secondary pollen.

In the Upper Durham Spruce zone (A-4) the amount of pine and deciduous tree pollen decreases relative to spruce, fir and larch pollen. Because pine is a prolific pollen producer, and many deciduous tree species appear to produce as much or more pollen than spruce (Davis and Goodlett, 1960), this change, which has been found in several pollen diagrams from southern New England, probably represents a decrease in the frequency of pine and deciduous trees relative to spruce, fir and larch within the areas contributing these pollen types. On the grounds that colder or moister climate would lead to this change in the vegetation, the Upper Durham Spruce zone has been correlated with the Valders stadium (Leopold, 1955, 1956, 1958; Davis, 1958; Ogden, 1959). Radiocarbon dates (Deevey, 1958) support this correlation.

Several genera which produce pollen very abundantly are represented by high pollen percentages in the Lower Pine zone (B-1). It is difficult to estimate the importance in a vegetational sense, therefore, of genera whose pollen occurs in low percentages, such as spruce, fir, larch and deciduous trees (other than oak). These genera may have been just as abundant in the vegetation as they were during the deposition of the spruce zone, while the frequency of pine, birch and oak trees increased only slightly.

Similarly, pine and oak are probably much overrepresented in zone B-2. Apparently pine was more abundant during this time than later in the forest history (Deevey, 1939), but its importance in the forest may be greatly exaggerated by the high frequency of its pollen in the sediments.

Changes in the percentages of pollen of aquatic plants are correlated with changes in sediment type and loss on ignition of the sediments (Figs. 2 and 3). *Typha* and *Myriophyllum* pollen is relatively abundant in the peat layer at 4.41–4.47 m, and *Isoetes* microspores are abundant in the overlying gyttja, particularly along the boundary between the green-brown gyttja and the gray-green gyttja. *Nuphar, Brasenia* and *Nymphaea* pollen is relatively abundant in the fine fibrous peat, which was apparently deposited in shallow water. The wood peat is the only truly terrestrial peat in the profile; in it pollen of aquatic plants is absent, and spores of sphagnum and ferns occur in relatively high percentages.

In many respects, the pollen diagram from Taunton is similar to late-

glacial pollen diagrams from other parts of southern New England. However, there are certain differences, the most conspicuous of which is the form of the spruce pollen curve. There is no spruce pollen maximum early in the A-zones, as recorded at Durham and Totoket, Connecticut (Leopold, 1955, 1956) and at Petersham and Athol, Massachusetts (Davis, 1958), but instead an increase throughout the A-zones, leading to a maximum in zone A-4. The minimum of spruce pollen in late A-1-2-3 appears to be an artifact imposed by the maximum of pine pollen at these levels, and probably does not represent a change in the size of the spruce population in the vegetation. Possibly a difference in the spruce species that were present in the vegetation of different regions is responsible for the differing percentages of spruce pollen in the Lower Durham Spruce zone.

Pollen diagrams available from southern New England (Fig. 1) show interesting regional differences in the ratio of spruce to pine pollen in the Durham Spruce zone. The ratios of spruce pollen to pine pollen are highest in pollen diagrams from Petersham and Athol, lower at Taunton and in southern Connecticut (Leopold, 1955; Leopold and Scott, 1958), and lower still in a diagram from Martha's Vineyard (Ogden, 1959). Leopold (1958) feels that the percentage of spruce pollen in late-glacial deposits is an indication of late-glacial summer temperatures. The controlling factors may have been more complicated, however, as percentages of other tree pollen types do not follow the spruce/pine pollen trend. For example, oak pollen percentages are highest at Taunton, next highest at Petersham and Athol, and lowest at Martha's Vineyard and Cambridge. The significance of regional differences in pollen percentages is difficult to assess, as the pollen percentages are relative, and many of the genera include several species which may vary in efficiency of pollen dissemination.

Stratigraphic Implications. According to the glacial chronology of New England as proposed by Flint (1953), ice retreated from southernmost New England during an interval prior to the Two Creeks interval, readvanced as far as Middletown, Connecticut, and an inferred border running northeastward from Middletown to Boston, Massachusetts, and retreated from this position during the Two Creeks interval. This chronology is disputed by Denny (1956), who believes that Massachusetts and Connecticut were deglaciated during the same interval, and that the readvance of ice at Middletown may have been a local readvance during the general glacial retreat. In this context the pollen diagram from Taunton has possible stratigraphic significance, because Taunton is located north of the moraines of southernmost New England, and south of Flint's proposed Middletown-Boston drift border. According to Flint's chronology, evidence of vegetational changes prior to the Two Creeks interval should be expected at Taunton.

Two Creeks pollen sequences at other sites in southern New England (Leopold, 1955, 1956; Davis, 1958, 1960b) include a spruce pollen zone, similar to the spruce pollen zone above 4.46 m at Taunton, underlain by an herb pollen zone. Despite the marked change in sediment type at 4.47 m at the Taunton site, sedimentation was apparently continuous. The peat layer at 4.41–4.47 m is unoxidized and contains well-preserved pollen. It may represent shallow water lake sediments, as the loss on ignition is similar to the overlying gyttja, and pollen of water plants is relatively abundant. Presumably the underlying sand and silty sand were deposited just prior to the time that spruce became abundant within the region contributing pollen, and are stratigraphically equivalent to sediments of the herb pollen zone at other sites.

No marked changes in the primary or secondary pollen spectrum appear to have occurred during the deposition of the sand and silty sand; the pollen spectra in all the samples are similar, except for an increase in birch pollen and decrease in pine pollen percentages in the upper samples. There is no evidence of a vegetational or climatic oscillation during their deposition. The loss on ignition of the sediments remains constant, whereas changes in loss on ignition are often characteristic of late-glacial sediments deposited at times of changing climatic conditions (Iversen, 1947). Although spruce pollen percentages are higher at 4.95 and 5.00 m than at 4.90 and 5.05 m, percentages of other pollen types, except sedge pollen, remain unchanged. The increase in spruce pollen percentages at these levels does not represent a major vegetational change, but may be due to a change in the rebedded pollen spectrum deposited in the sediments, or to a decrease in the pollen production of the local sedge population. Similar anomalies in pollen percentages have been found in late-glacial silty sands at Cambridge (Davis, 1960b), where the percentages of spruce and sedge pollen are different at equivalent stratigraphic levels in the two sample series. The cause of the anomalies is not understood, but because the two series of samples give inconsistent results it is doubtful that regional vegetational changes are involved.

There is some evidence, albeit not conclusive, that deposition of sand began at the site soon after active ice movement ceased. The sequence of sediment types suggests that the sand, silty sand and shallow-water peat may have been deposited in a shallow depression, and that the overlying gyttja was deposited after melting of the underlying ice block had deepened the depression. The presence of pollen (including exotic genera) in varved clay in the vicinity and its virtual absence in the local till suggests that secondary pollen was deposited in the clay by meltwater streams flowing from the vicinity of Tertiary sediments 25 miles to the northeast (Davis, 1960a). Secondary pollen was also deposited in the bog sediments, either

by meltwater streams flowing into or over the site of deposition, or through the erosion and redeposition of meltwater stream deposits. In the first case, deposition occurred early in late-glacial time, when extensive masses of ice still provided a source for meltwater. In the second case, however, an interval of time might have elapsed before sedimentation began.

The pollen in the bog sediments at Taunton indicates that deposition of sediments there began during the Two Creeks interval, but because it is questionable that the sediments represent the entire interval of time since deglaciation, the pollen sequence cannot be used as definitive evidence regarding the age of the glacial drift. However, the evidence that the sequence is complete is at least as good at Taunton as it is at Petersham and Athol, where similar pollen sequences, deposited during the Two Creeks interval, have been found. The usefulness of pollen diagrams for glacial stratigraphy is limited by the difficulty of proving that any pollen sequence is complete.

SUMMARY

1. Pollen analyses of sediments from 2.55–5.20 m depth in a bog near Taunton, in southeastern Massachusetts, are presented in a pollen diagram.

2. The pollen sequence in the organic sediments includes the Lower Durham Spruce pollen zone (A-1-2-3), deposited during the Two Creeks interval, the Upper Durham Spruce zone (A-4), deposited during the subsequent Valders time, and the Lower and Upper Pine zones (B-1 and B-2). The overlying peat was not analyzed. The underlying highly inorganic sediments, which are contaminated with secondary pollen, are apparently stratigraphically equivalent to the Herb pollen zone (T or T-3) at other sites.

3. The pollen diagram differs from others in that the ratio of spruce to pine pollen in zones A-1-2-3 and A-4 is lower than at Petersham and Athol, and higher than at sites nearer the coast. Spruce pollen percentages do not reach a maximum early in the spruce pollen zone, as at some other sites, but increase throughout zone A-1-2-3. Oak pollen percentages in zone A-1-2-3 are higher than recorded at other sites.

4. There is no evidence that a vegetational or climatic oscillation prior to the Two Creeks interval occurred after deposition of the sediments began.

California Institute of Technology
Pasadena, California
Present Address
Department of Botany
Universty of Michigan
Ann Arbor, Michigan

Literature Cited

Davis, M. B. 1958. Three pollen diagrams from central Massachusetts. Amer. Jour. Sci. **256**: 340–370.

————. 1960a. The problem of rebedded pollen in late-glacial sediments at Taunton, Massachusetts. Amer. Jour. Sci.: in press.

————. 1960b. Pollen analysis of a late-glacial deposit at Cambridge, Massachusetts. Manuscript.

Davis, M. B. and **J. C. Goodlett.** 1960. Comparison of the present vegetation with pollen spectra in surface samples from Brownington Pond, Vermont. Ecology **41**: 346–357.

Deevey, E. S., Jr. 1939. Studies on Connecticut lake sediments. Amer. Jour. Sci. **237**: 717–752.

————. 1958. Radiocarbon-dated pollen sequences in eastern North America. Veröff. Geobot. Inst. Rübel in Zürich **34**: 30–37.

Denny, C. S. 1956. Wisconsin drifts in the Elmira region, New York, and their possible equivalents in New England. Amer. Jour. Sci. **254**: 82–95.

Faegri, K., and **J. Iversen.** 1950. Text-book of modern pollen analysis. Copenhagen, Ejnar Munksgaard, 168 p.

Flint, R. F. 1953. Probable Wisconsin substages and later Wisconsin events in northeastern United States and south-eastern Canada. Geol. Soc. America Bull. **64**: 265–287.

Frey, D. G. 1951. Pollen succession in the sediments of Singletary Lake, North Carolina. Ecology **32**: 518–533.

Iversen, J. 1947. Plantevaekst, dyreliv og klima i det senglaciale Danmark. Geol. Fören. i Stockholm Förh. **69**: 67–78.

Leopold, E. B. 1955. Climate and vegetation changes in southern Connecticut, during the Two Creeks interstadial. Unpubl. Ph.D. Thesis, Yale Univ.

————. 1956. Two late-glacial deposits in southern Connecticut. Proc. Natl. Acad. Sci. **42**: 863–867.

————. 1958. Some aspects of late-glacial climate in eastern United States. Veröff. Geobot. Inst. Rübel in Zürich **34**: 80–85.

Leopold, E. B. and **R. A. Scott.** 1958. Pollen and spores and their use in geology. Smithsonian Report **1957**: 303–323.

Ogden, J. G., III. 1959. A late-glacial pollen sequence from Martha's Vineyard, Massachusetts. Amer. Jour. Sci. **257**: 366–381.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 87, NO. 4, pp. 271–275 JULY, 1960

VITAMIN REQUIREMENTS OF GLEOCERCOSPORA SORGHI[1]

ISAAC MALCA AND A. J. ULLSTRUP[2]

During the testing of various agar substrates for their ability to stimulate sporulation in *Gleocercospora sorghi* D. Bain & Edg., all synthetic media lacking vitamins either failed completely to support growth or permitted only sparse and limited development of the mycelium. Media prepared with vegetable extracts supported good growth. Failure to grow on synthetic media was true for all cultures isolated from typical lesions this pathogen incites on sorghum leaves (*Sorghum vulgare* Pers.) (Bain and Edgerton, 1943). Leaves from which isolations were made were collected from several locations in southern Indiana in 1953 (Ullstrup and Laviolette, 1959).

Inability of the fungus to grow on synthetic media suggested its need for one or more vitamins. The experiments described herein were undertaken to test this hypothesis.

Methods and Materials. The basal medium used to determine vitamin requirements consisted of D-glucose, 25.0 g.; casein hydrolysate, 2.0 g.; KH_2PO_4, 1.0 g.; $MgSO_4$, 0.5 g.; microelement solution,[3] 2 ml.; de-ionized, glass-distilled water, to make 1 liter of medium. The D-glucose and casein hydrolysate were dissolved in the water, the solution boiled 20 minutes with activated charcoal, filtered through Whatman No. 2 filter paper and then the mineral salts and vitamins were added. The medium after making up to volume was adjusted with NaOH to pH 5.8 before sterilization. All glassware was washed in sulphuric acid-dichromate cleaning solution and thoroughly rinsed with de-ionized water.

Vitamins were added to the basal medium before sterilization, in amounts described. Twenty milliliters of medium was pipetted into 50-ml. erlenmeyer flasks and the latter plugged with "Disposo-plugs" (foam plastic). In the

[1] Contribution from the Department of Botany and Plant Pathology, Purdue University, Lafayette, Indiana, and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture. Journal Paper No. 1591 of the Purdue Agricultural Experiment Station.

[2] Graduate Research Assistant, Department of Botany and Plant Pathology, Purdue University (Present Address, Department of Agronomy, University of California, Davis, California) and Pathologist, Department of Botany and Plant Pathology, Purdue University and ARS, USDA.

[3] $Fe(NO_3)_3 \cdot 9H_2O$, 723.5 mg.; $ZnSO_4 \cdot 7H_2O$, 439.8 mg.; $MnSO_4 \cdot 4H_2O$, 203.0 mg. Sulphuric acid was added to clear the solution and the volume was made up to 1 liter.

vitamin-dosage experiments 125-ml. flasks were used. All media were sterilized by autoclaving at 15 pound's pressure and 120°C. for 15 minutes.

A single-spore culture of *G. sorghi*, recently isolated from an infected sorghum leaf, was used throughout the experiments. The fungus was maintained on glucose-yeast extract agar on which it sporulated well when exposed to light. Spores used to seed media were removed from a 10- to 14-day-old culture and rinsed 3 times with sterile, de-ionized, glass-distilled water. Each flask was seeded with 0.2 ml. of a spore suspension diluted to about 1000 spores/ml.

Neurospora tetrasperma Shear & Dodge was used to detect biotin, and *Saccharomyces cerevisiae* Hansen for the biossay of both biotin and thiamin.

Cultures of *G. sorghi* and of *N. tetrasperma* were incubated in the dark at 22.5°C. in surface culture. *S. cerevisiae* was incubated in an illuminated room at 22.5°C. in a reciprocating shaker operating at 90 to 100 6-inch strokes per minute.

Growth of *G. sorghi* was determined on the basis of dry weight of mycelium produced after stated periods of incubation. Mycelial mats were harvested on previously dried and weighed Whatman No. 2 filter paper, rinsed twice with de-ionized water, dried at 80°C. for 24 hours, cooled to room temperature over calcium chloride in a desiccator, and weighed to the nearest milligram. Correction factors were introduced to compensate for the gain in weight of the papers due to adsorption of moisture after repeated uncovering of the desiccator.

Results and Conclusions. The basal medium containing no vitamins and media supplemented with biotin (5 μg./1.), insitol (5 mg./1.), thiamin · HCl (100 μg./1.), pyridoxin · HCl (100 μg./1.), p-aminobenzoic acid (2 μg./1.), and pantothenic acid (100 μg./1.), either singly or in various combinations, were seeded with *G. sorghi*. No growth occurred on media lacking both biotin and thiamin; only slight growth (10 mg. or less) took place on media with either one of these 2 vitamins. The average dry weight of mycelial mats of *G. sorghi* on media containing both biotin and thiamin was 180 mg. after 16 day's incubation, but it dropped to 138 mg. after 35 days of incubation, suggesting that autolysis had taken place. Supplementing the medium containing both thiamin and biotin with one or more of the other vitamins listed did not affect the growth of the fungus or the rate of autolysis. The slight amount of growth obtained on media containing either biotin or thiamin, but not both, was due to contamination of slight amounts of these vitamins as indicated by visual examination of the development of the organisms used to test for these vitamins. These results suggested that both biotin and thiamin are necessary for growth of *G. sorghi* and that other vitamins did not influence growth.

No appreciable differences in total growth occurred at concentrations of thiamin ranging from 25 μg./1. to 200 μg./1. at any of the levels of biotin used (Table 1). In general less growth took place at 1 μg. than at 5 or 10

TABLE 1. *Effect of different dosages of biotin and thiamin · HCl on the growth of Gleocercospora sorghi.*

Days of Incubation	Biotin (μg./1.)	Dry weight of mycelium* on media containing indicated amount of thiamin · HCl (μg./1.)				
		25	50	100	150	200
		mg.	mg.	mg.	mg.	mg.
6	1	96	86	77	81	75
	5	101	100	106	94	100
	10	91	105	114	108	104
12	1	160	172	155	162	171
	5	209	196	184	204	187
	10	188	194	185	199	188
18	1	180	175	176	177	173
	5	189	191	185	192	189
	10	190	190	192	192	191

* Average weight harvested from 4 flasks.

μg. of biotin/1. but the differences were not great. Mycelial development was slightly less at 10 μg./1. of thiamin/1. after 6 and 8 days of incubation, but not after 11 or 15 days (Table 2). The fungus grew equally well at con-

TABLE 2. *Effect of dosages of thiamin · HCl on growth of Gleocercospora sorghi.*

Thiamin · HCl* (μg./1.)	Dry weight of mycelium after indicated incubation period**			
	days			
	6	8	11	15
	mg.	mg.	mg.	mg.
0	6	2	6	4
10	80	161	192	190
50	107	173	191	191
100	95	174	197	178
250	106	173	193	180
400	92	173	197	182
600	96	175	200	180
1000	102	170	193	180

* Biotin concentration 10 μg./1.
** Average dry weight of 4 mycelial mats

centrations of thiamin ranging from 50 μg./. to 1 mg./1. Although the rate of growth was slower at 10 μg. thiamin/1., the maximum dry weight attained was the same as that at higher concentrations.

Since the total dry weight of mycelium was about the same at a concentration of 10 μg./1. of thiamin as when grown in a medium containing higher concentrations of the vitamin, and since 1 μg. of biotin was near-optimal, an

experiment was designed to determine the effect of low concentrations of these vitamins on growth of *G. sorghi*. The results in table 3 show a gradual

TABLE 3. *Effect of minimal concentrations of thiamin · HCl and biotin on growth of Gleocercospora sorghi.*

Thiamin · HCl* (μg./1.)	Biotin** (μg./1.)	Dry weight of mycelium after indicated incubation period***			
		days			
		6	11	14	17
		mg.	mg.	mg.	mg.
0.00		0	2	3	8
	0.00	0	4	0	1
0.02		5	23	23	16
	0.02	5	12	12	10
0.10		10	30	40	42
	0.10	17	41	51	68
0.50		18	49	64	69
	0.50	86	172	178	173
1.00		17	73	92	99
	1.00	104	200	197	189
2.00		23	108	139	147
	2.30	109	222	216	196
4.00		48	150	171	165
	5.00	115	227	222	202
8.00		44	185	192	162

* 5 μg. biotin/1. in this medium.
** 100 μg. thiamine · HCl/1. in this medium.
*** Average dry weight of 4 mycelial mats.

increase in dry weight of mycelium with increasing amounts of biotin up to about 0.5 μg./1.; thereafter the growth curve tended to level off. The optimum concentration of thiamin appears to be between 10 and 25 μg./1. but growth occurs at concentrations of thiamin as low as 0.02 μg./1.

SUMMARY

These experiments indicate that *Gleocercospora sorghi* requires both thiamin and biotin for growth. The optimal biotin concentration is approximately 5 μg./1. although the fungus was able to grow almost as well on media containing 0.5 μg. to 10 μg./1. of biotin. Growth was best at 25 μg. of thiamin · HCl/1., but there was little difference over a range of 10 μg to 1 mg. of the vitamin/1. Growth occurred when the concentration of biotin or of thiamin was as low as 0.02 μg./1. Other vitamins, added singly or in various combinations, did not support growth of the fungus, nor was its growth enhanced by the addition of other vitamins to a medium containing biotin and thiamin.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY
PURDUE UNIVERITY
LAFAYETTE, INDIANA

Literature Cited

Bain, Douglass C. and **Edgerton, C. W.** The zonate leaf spot, a new disease of sorghum. Phytopathology **33**: 220–226, 1943.

Ullstrup, A. J. and **Laviolette, F. A.** Diseases of corn and sorghum in Indiana in 1958. Plant Disease Reporter **43**: 334–336, 1959.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 87, NO. 4, PP. 276–279 JULY, 1960

MOSSES OF THE RARITAN RIVER FLOOD PLAIN, NEW JERSEY

WARREN A. WISTENDAHL

As part of a comprehensive ecological study of the flood plain of the Raritan River in New Jersey (Wistendahl, 1958), collections were made of mosses found in several flood plain habitats. Since relatively little information is available on the moss flora of flood plains, it seemed advisable to record the moss flora separately from the flood plain vascular flora. No attempt was made to collect and identify all the species growing on the Raritan River flood plain system, but most of the species growing on three study areas are listed here.

Nomenclature for mosses follows that of Grout (1940); for vascular plants, Fernald (1950). Specimens of species included have been deposited with the Chrysler Herbarium, Rutgers University. The author thanks Dr. Edwin T. Moul of Rutgers University for his assistance with the identification of species.

Three areas on the Raritan River flood plain system were studied in detail. One was approximately one mile below the town of Burnt Mills. A second was an area known locally as Mertensia ("Island") Woods located near the city of Raritan. The third was at Raritan Landing near New Brunswick. The locations of these areas have been mapped and the dynamics of flood plain formation described (Wistendahl, 1958). All collections of mosses were made during the years 1952 through 1955.

The mosses of the Burnt Mills area were collected from three flood plain communities; the outer flood plain, the inner flood plain, and the terrace. The tree species composition of these areas has been described by Buell and Wistendahl (1955).

The outer flood plain or natural levee supports a mixture of woody species. Many of the trees are large, indicating that this community has existed for a long period of time. The major tree species are sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), tulip-tree (*Liriodendron tulipifera*), and basswood (*Tilia americana*). Flooding is occasional with a trend toward erosion rather than deposition.

Moss species of the outer flood plain are: *Atrichum undulatum, Dicranella rufescens, Entodon seductrix, Eurhynchium hians,* and *Leskea nervosa.*

The inner flood plain at Burnt Mills, being low, is frequently inundated

and receives much of the force of flood waters. The major tree species are red maple (*Acer rubrum*), boxelder (*Acer negundo*), and river birch (*Betula nigra*). Sugar maple, tulip-tree, and some oaks occupy the higher ground. The soil is poorly drained and depressions may contain water all seasons of the year.

Mosses of the inner flood plain are: *Amblystegium varium, Atrichum angustatum, Campylium hispidulum, Climacium americanum, Dicranella heteromalla* var. *orthocarpa, Entodon seductrix, Heterophyllium haldanianum, Leskea gracilescens, Leskea nervosa, Pogonatum pensilvanicum,* and *Polytrichum ohioense.*

The terrace, located about 240 meters from the river and rising about 7 feet above it, is rarely flooded. The soil is generally well-drained with occasional depression areas of poor drainage. The terrace supports a mesophytic forest of sugar maple, beech, basswood, black oak (*Quercus velutina*), and red oak (*Quercus rubra*). The forest floor is almost uniformly covered with may-apple (*Podophyllum peltatum*) in the spring of the year.

Mosses of the terrace are: *Atrichum undulatum* and *Ceratodon purpureus.*

The flood plain at Mertensia Woods is similar to that of the outer flood plain at Burnt Mills in that it supports a mixture of mature trees. It differs in that it is primarily an area of alluvial deposition. The area is fringed by sand bars which support willow (*Salix nigra*) thickets. Silver maple (*Acer saccharinum*), river birch, and boxelder are common on the river bank. Large individuals of hackberry (*Celtis occidentalis*) are present in the forest with white ash, American elm (*Ulmus americana*), and slippery elm (*Ulmus rubra*).

Mosses of Mertensia Woods are: *Atrichum undulatum, Dicranella heteromalla* var. *orthocarpa, Eurhynchium hians,* and *Heterophyllium haldanianum.*

The flood plain at Raritan Landing has been greatly disturbed by man. The area consists of borders of trees along the river and abandoned farmlands, old fields, small woodlots, and a marsh located behind the natural levee of the flood plain. At the time of this writing, much of the marshland has been filled to provide more land for an expanding county park system.

Mosses of the Raritan Landing area are: *Amblystegium serpens, A. varium, Atrichum undulatum, Brachythecium oxycladon, Campylium chrysophyllum, C. hispidulum, Cratoneuron filicinum, Dicranella heteromalla* var. *orthocarpa, Ditrichum pallidum, Heterophyllum haldanianum, Mnium affine, M. cuspidatum, Physcomitrium turbinatum, Pleuridium subulatum, Pohlia nutans,* and *Polytrichum ohioense.*

When tabulated (Table 1), the occurrence of the species of mosses on the

TABLE 1. *Occurrence of mosses at three locations on the flood plain of the Raritan River. Communities at Burnt Mills are as follows: O. F.—Outer flood plain, I. F. inner flood plain, T.—terrace*

Species	O.F.	Burnt Mills I. F.	T.	Mertensia Woods	Raritan Landing
Amblystegium serpens					X
A. varium		X			X
Atrichum angustatum		X			
A. undulatum	X		X	X	X
Brachythecium oxycladon					X
Campylium chryso-phyllum					X
C. hispidulum		X			X
Ceratodon purpureus			X		
Climacium americanum		X			
Cratoneuron filicinum					X
Dicranella heteromalla var. *orthocarpa*		X		X	X
D. rufescens	X				
Ditrichum pallidum					X
Entodon seductrix	X	X			
Eurhynchium hians	X			X	
Heterophyllium haldani-anum	X	X		X	X
Leskea gracilescens		X			
L. nervosa	X	X			
Mnium affine					X
M. cuspidatum					X
Physcomitrium tur-binatum					X
Pleuridium subulatum					X
Pogonatum pensilvanicum		X			
Pohlia nutans					X
Polytrichum ohioense					X
Total (25)	6	10	2	4	16

flood plain areas shows great diversity. Of the 25 species identified, only three, *Atrichum undulatum*, *Dicranella heteromalla* var. *orthocarpa*, and *Heterophyllium haldanianum*, were common to all three study areas. The Burnt Mills and Raritan Landing areas had the largest number of species, 15 and 16 respectively. This is undoubtedly due to the greater size and larger number of habitats at these locations than at Mertensia Woods.

This study, indicating that species of mosses are not uniformly distributed throughout a flood plain system, suggests that a more exhaustive study would reveal moss habitat preferences as related to the dynamics of flood plain formation.

OHIO UNIVERSITY,
ATHENS, OHIO

Literature Cited

Buell, M. F. & W. A. Wistendahl. 1955. Flood plain forests of the Raritan River. Bull. Torrey Bot. Club. **82**: 463–472.

Fernald, M. L. 1950. Gray's Manual of Botany. 8th ed. New York: American Book Company.

Grout, A. J. 1940. List of mosses of North America north of Mexico. Bryologist **43**: 117–131.

Wistendahl, W. A. 1958. The flood plain of the Raritan River, New Jersey. Ecol. Monogr. **28**: 129–153.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 87, NO. 4, pp. 280–289 JULY, 1960

TORREYA

Morton Eaton Peck

Helen M. Gilkey

In a log house on a farm near La Porte City, Iowa, Morton Peck was born, and in that state received his formal education. After high school he attended Cornell College, from which he received his Bachelor's degree in 1895, and later his Master's.

In 1903, after several years of teaching at Ellsworth College, he and a friend left Waterloo, Iowa, for a collecting trip in Central America. By row boat they traveled down the Cedar River to the Mississippi, thence on to Vicksburg, Mississippi where, according to his diary, "it was hard work and we were getting tired, and the autumn was coming on; so we sold our outfit to some wharf roustabouts, and took the train for New Orleans." They had thought to go to Yucatan, but were persuaded to give up the plan because of an Indian uprising, and British Honduras was decided upon, instead. By fruit steamer they made the journey, and spent an adventurous year collecting birds and mammals.

MORTON EATON PECK
March 12, 1871–December 4, 1959

These were mounted by Morton's taxidermist and naturalist father, and later deposited at Willamette University at Salem, Oregon.

Returning to Ellsworth College, Mr. Peck became acquainted with an enthusiastic young biology student, Jessie Grant; and, when in 1905 he set out on another trip into British Honduras, it was on his wedding day, and he was accompanied by his bride, Jessie. For two years they made intensive study of the flora and fauna of this Central American country, their plant collections going to Harvard, Columbia, and other institutions in America, as well as to several in Europe. Bird skins and eggs were sent to the Carnegie Museum, and insects to various universities.

After their return to their home state, Mr. Peck taught at Iowa Wesleyan College until 1908 when he accepted a position at Willamette University in Oregon, where he remained as Professor of Biology until his retirement in 1941.

His interest in plants and animals dated, he often said, from his earliest memories when he was frequently carried upon his father's back into the deep woods of the farm, where the two spent many hours becoming acquainted with the wild life of the region. Throughout his active years, field work was his delight; and during his 51 years in Oregon he built up a collection of its plants and a knowledge of its furthest bounds, probably unequalel by any other student of the state's biological riches. Free, each summer, from University responsibilities, he and his wife spent these months, year after year, exploring Oregon and contributing to the Peck Herbarium which contains perhaps the most nearly complete representation of Oregon plants in existence.

Many new species were discovered during this joint field project, and named by Dr. Peck. The bibliography which follows indicates his industry in field and laboratory. His best-known work is the Manual of the Higher Plants of Oregon, a basic key to the flora of the state; and, during its years of preparation, almost a pioneer undertaking. The manuscript of a second edition was completed shortly before his death, and is soon to be published.

That the sensibilities of a true scientist extend beyond the purely technical aspects of his own field, is exemplified in Dr. Peck. Included in his publications is a book of poems which are deep, philosophical, and expressed in singing words.

Even in the field of Botany his interests were not narrow. In his student years in Iowa, and later in Oregon, he amassed and named nearly a thousand of those curious fungi, the Myxomycetes; and later this collection was presented to Willamette University, where his phanerogamic herbarium likewise is housed. During his study of these fungi, he often appealed to the late Dr. Thomas Macbride, formerly of the University of Iowa for help; and "out of this," reports Mrs. Peck, "grew a lasting friendship. Many times in later years, they met and worked together with these tiny, beautiful plants."

Honors bestowed upon him were: the degree of Doctor of Science, awarded in 1940 by Cornell College; Doctor of Literature in 1955 by Willamette University; citation, in 1943, jointly by Phi Beta Kappa and Sigma Xi as "the outstanding scientist of the State of Oregon"; and, in 1958, citation by the Oregon Federation of Garden Clubs for "distinguished research in Horticulture."

Dr. Peck was a member of Phi Beta Kappa, Sigma Xi, A.A.A.S., Botanical Society of America, American Society of Plant Taxonomists, California Academy of Sciences, Iowa Academy of Sciences, Oregon Academy of Sciences, California Botanical Society, California Ornithological Society, and the American Ornithological Union (honorary, 1909).

In addition to his three years of scientific research in Central America, he studied at Kew Gardens, the British Museum of Natural History, the University of Edinburgh, and at many of the larger herbaria in America.

An appreciation of Dr. Peck, published in the Willamette Collegian of Feb. 18, 1938, sums up the attitude of all those so fortunate as to have worked under his tutelage or to have been associated with him in any capacity: "Professor Peck is beloved as a friend of the students, admired as a professor, and respected as a man. His broad perfect knowledge of his work, and his earnest constructive application, mark him as worthy of the respect held for him." A former student who sang at his funeral service said: "To me he has always been one of the Immortals."

Whether at home or in the herbarium, Dr. and Mrs. Peck were gracious host and hostess to students, staff members, visiting botanists, and their many friends. Those who knew him were impressed not alone by his enthusiasm and vast store of knowledge, but also by his gentleness and modesty, his quick sense of humor, his patience and industry, and his understanding. Such teachers of the "old school" can never quite be replaced. Our sympathy extends to the one who worked by his side through all his accomplishments, and who helped ease the load when the years began to take their toll. Her collaboration, together with his indomitable will, made it possible for his activities to continue late into his 88th year.

BIBLIOGRAPHY

A list of flowering plants of Hardin County. Proc. Ia. Acad. Sci. **12**: 193–241. 1905.

Protective adaptations in the nesting habits of some Central American birds. Proc. Ia. Acad. Sci. **15**: 177–182. 1908.

Flora of the east slope of the Cascade Mountains in Crook County, Oregon. Proc. Ia. Acad. Sci. **22**: 143–164. 1915.

A section of the Upper Sonoran flora in northern Oregon. Proc. Ia. Acad, Sci. **23**: 317–334. 1916.

Study of a section of the Oregon coast flora. Proc. Ia. Acad. Sci. **26**: 337–362. 1919.

Vegetation of Cape Blanco, Oregon. Proc. Ia. Acad. Sci. **27**: 85–89. 1920.

Book of the Bardens. (A volume of poetry.) Gorham Press. 1923.

A preliminary sketch of the plant regions of Oregon, I. Western Oregon. Am. Jour. Bot. **12**: 33–49. 1925.

A preliminary sketch of the plant regions of Oregon, II. The Cascade Mountains and eastward. Am. Jour. Bot. **12**: 69–81. 1925.

New plants from Oregon. Torreya **28**: 53–57. 1928.

More new plants from Oregon. Torreya **32**: 147–153. 1932.

Myxomycetes of northwest Oregon. (With Henry Gilbert.) Am. Jour. Bot. **19**: 131–147. 1932.

New Oregon plants. Proc. Biol. Soc. Wash. **47**: 185–188. 1934.

Three interesting new plants from Wallowa County, Oregon. Rhodora **36**: 266–268. 1934.

Six new plants from Oregon. Proc. Biol. Soc. Wash. **49**: 109–112. 1936.

New plants from Oregon. Proc. Biol. Soc. Wash. **50**: 93–94. 1937.

Some new species and varieties of Oregon plants. Proc. Biol. Soc. Wash. **50**: 121–123. 1937.

A manual of the higher plants of Oregon. 1–866. Metropolitan Press (Binfords and Mort). 1941.

Two new Compositae from the Wallowa Mountains of Oregon. Madroño **5**: 247, 248. 1941. (With E. I. Applegate.)

A new *Frasera* from Oregon. Madroño **6**: 12. 1941.

New plants from Oregon. Madroño **6**: 13–15. 1941.

Combinations proposed in the higher plants of Oregon. Madroño **6**: 133–137. 1941.

Some interesting plants of Malheur County, Oregon. Leafl. West. Bot. **4**: 177–186. 1945.

James C. Nelson. (With portrait.) Rhodora **47**: 65–68. 1945.

Certain plant species of the canyon of Hurricane Creek, Wallowa County, Oregon. Madroño **9**: 1–8. 1947.

Native rhododendrons of the Pacific northwest. Rhododendron Yearb. **1947**: 87–89. 1947.

Certain Oregon saxifrages. Leafl. West. Bot. **5**: 58–60. 1947.

A new species of *Polygonum* from Oregon. (With Marion Ownbey.) Madroño **10**: 250, 251. 1950.

Impatiens Roylei Walb. in Quebec. Leafl. West. Bot. **6**: 72. 1950.

Notes on certain Oregon plants, with descriptions of new varieties. Leafl. West. Bot. **7**: 177–190. 1954.

A new *Calochortus* from Oregon. Leafl. West. Bot. **7**: 190–192. 1954.

A new *Corydalis* from Oregon. Leafl. West. Bot. **8**: 39, 40. 1956.

Clara Chapman Hill

Mrs. Clara Chapman Hill, author of A Spring Flora of the Lower Columbia Valley (1958, reviewed in Bull. Torrey Club **86**: 421, 1959), passed away at her home in Corvallis, Oregon, on January 22nd, 1960.

At the time of her illness, Mrs. Hill was instructor in botany at Oregon State College, and engaged in completing requirements for the degree of Doctor of Philosophy which she would have received on June 6th. She held the degrees of Bachelor and Master of Science, both from O.S.C. The subject of her Master's thesis, published in collaboration with the late Dr. Ethel I. Sanborn, was Moss Flora of the Willamette Valley, Oregon. (Oregon State Monographs, Studies in Botany, no. 5. 1941).—Helen M. Gilkey.

A Note About the Late Dr. Gundersen of the Brooklyn Botanic Garden

It seems possible that I was more closely and intimately associated with dear Dr. Gundersen than any living being outside his own family. He shared my home in Brooklyn, N. Y. for eighteen years of his professional life as Curator of the Herbarium, Brooklyn Botanic Garden, and stopped in my own quarters nearly every evening after his hours of reading at the Brooklyn Botanic Garden Library. Here he was always a welcome guest, and often brought to myself some freshly acquired bit of information along scientific lines. His memory and store of knowledge were profound.

He came to me often for my opinion or advice concerning customs or ethics about which he felt small concern unless driven by necessity. When graduating from the Sorbonne in Paris to take his degree, it made quite a commotion when he refused to wear the customary robe of ermine. His code of ethics forbade the slaughter of animals for human display or pleasure of palate. He regarded evening dress for gentlemen as "queer clothes." How well I recall the afternoon of the wedding of Prudence Gager, (daughter of Dr. C. Stuart Gager, then Director of the Garden) when, about two hours before the ceremony, Mrs. Gundersen came down to me in tears, pleading with me to persuade "Alfred" to hire a tuxedo since they were to attend the reception. I did act and directed him just where he could rush out, opposite the L.I.R.R. Station, and hire a complete outfit fitted to his figure, which he did, though under protest, I know.

I dare say the New York Vegetarian Society would enjoy reading that during his entire adult life of over fifty years he never tasted meat.—Frank Stoll, *formerly of the Brooklyn Botanic Garden Staff*.

Field Trip Reports

April 10. St. Jonn's in the Wilderness, Sloatsburg, New York. This was the latest Palm Sunday date since the inception of this yearly meeting yet not a single herb, shrub, or tree was seen in flower. The group hiked to Breakneck Pond before attending the annual service (see Torreya in Bull. Torrey Club **81**: 460, 1954; **82**: 397, 1955; **83**: 385, 1956; **84**: 318, 1957; **85**: 273, 1958; **86**: 348, 1959). The altitude of the area surrounding Breakneck Pond is over 1,000 feet and not a single plant of *Symplocarpus foetidus* (skunk cabbage) was seen. This observation confirms a statement in McVaugh's Flora of Columbia County, New York* which reads "not recorded for elevations above 300 m." The absence of this common early spring flower from the wet areas came as a surprise to most of the group. Attendance: Torrey 6, Rockland-Audubon 12. Leader, J. Harry Lehr.

April 23. Silver Lake to West Brighton, S. I. Many of the flowering crab trees in Silver Lake Park were being attacked by tent caterpillars. There were observed several species of evergreens—Scotch pine, hemlock, and spruces. In Goodhue Woods the large tulip trees were impressive. Spice bush, skunk cabbage, and trout lily were in bloom. Also a pear and a crabapple tree were blooming. A large plant of cut-leaved blackberry, *Rubus laciniata* was found.

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* McVaugh, Rogers. Flora of the Columbia County Area, New York. New York State Museum Bull. 360, 1958.

Birds observed were: robin, yellow-palm warbler, pheasant and ruby-crowned kinglet. As further reward, refreshments were served at the house of the leader. Attendance: 25. Leader, Mathilde P. Weingartner.

May 1. Stony Brook Trail, Sloatsburg, New York. Incessant rains caused the cancellation of this trip and the opportunity it would have afforded to see *Equisetum scirpoides* at what is believed to be its southernmost station in the eastern United States. This station was last seen by the leader in 1954. Leader, J. Harry Lehr.

May 5. "Night Sounds Hike" in S.I. This was a joint venture with the Nature Section of the S.I. Museum. We met at the corner of South Avenue and Forest Avenue and from there drove to Lambert's Lane. The sun was just setting and many birds were singing their evening song. Redwinged blackbird, towhee, song sparrow, brown thrashers, field sparrow, and mourning dove were identified. When it was almost dark the woodcock began his courting duties, and a whip-poor-will began to whoop it up. We could hear Fowler's toads from a distance and at a nearby pond we observed peepers blowing out the bubbles at their throats as they sang. We then journeyed to another pond where we saw and heard the Fowler's toads and green frogs. Attendance: 45. Leader, Robert Mathewson.

May 14. Van Cortlandt Park, N. Y. Despite the promise of rain and the intermittent showers which occurred during the walk, approximately 25 members and guests turned out for the trip around the remnants of the swamp in the western part of Van Cortlandt Park, and to the northern section of the park over the ridges and the rather undisturbed areas lying between the ridges and Saw Mill River Parkway. On the ledges of the ridges, *Silene Caroliniana* var. *Pennsylvanica* still grew rather abundantly. The expected spring flowers were plentiful, but to the leader, a surprising find was the wild coffee (*Triosteum aurantiacum*) still in an early stage. It had been found some years before in about the same spot, and apparently persists, though sparsely. Leader, William Rissanen.

May 22. Kittatinny Ridge, N. J. The views from the ridge were obscured by a persistent fog, which occasionally drizzled. Painting blazes was out but they were in good condition from last fall's painting. Brush and several sizeable logs were removed from the trail. Upon reaching Millbrook Road the tools were put aside and we botanized the return route. *Rhododendron canescens* and *R. nudiflorum* were most conspicuous of the flowering shrubs but an abundance of another heath, *Vaccinium stamineum*, was noted. The three-lobed violet (*V. triloba*) was common and a few plants of the bird-foot violet were found. The presence of stemless lady's slipper along the Appalachian Trail always delights us. In all we recorded 44 plants in bloom and 7 species of ferns.

It was a real pleasure to have a work party show up on such an unpromising morning, equipped with tools and rain garb. Attendance: 6. Leader, John A. Small.

May 28. Great Kills Park, S.I. At a small pond near Hylan Blvd. there was a lovely stand of yellow iris. Some Scotch pine also grow in this area. The greater part of Great Kills Park is built on "landfill" and there are numerous adventives growing here. Many of these are being crowded out by *Phragmites communis* but others are standing their ground. Among these are an oriental fern, pokeweed, *Anthemis cotula, Artemisia absinthium, Prunus serotina, Bromus tectorum*, and *Krigia virginica.*

On the shore of the Yacht Basin many horseshoe crabs were landing in tandem to lay their eggs. Shorebirds were not very plentifull but sanderlings, semipalmated sandpipers, ruddy turnstones, black-bellied plovers, knots, and semipalmated plovers were observed. Two killdeer were putting on their broken-wing act trying to divert us from finding their young. A pair of horned lark were singing while flying overhead. Attendance: 16. Leader, Mathilde P. Weingartner.

Local Flora Notes

The author of these notes has been making an inquiry into the local floras of the Torrey range which have been written and published since the publication of Taylor's Flora of the Vicinity of New York in 1915. There have been few, but among these were a flora of Waterbury, Connecticut and a flora of Northampton County, Pennsylvania. In neither instance were these two floristic studies reviewed in "Torreya." In the belief

that many of the people participating in our local field trips or studying the flora of the Torrey Range may find it useful to have an evaluation of these studies, even though a belated one, the writer has made an effort to correct this omission by corresponding with persons more familiar than he with the areas in question.

Personal correspondence with Mr. Leonard J. Bradley, President of the Connecticut Botanical Society and botanist at the Greenwich Audubon Center elicited the following:

"Flora of Waterbury, Connecticut, and Vicinity by Arthur Edmund Blewitt. Published privately in 1926. Here is a most complete list of the ferns and flowering plants of a very interesting section of Connecticut. In the preface, the author gives a brief but very graphic account of the physical features of the area. His list of credits indicates that he has not hesitated to seek expert advice with the more difficult genera and nomenclature.

"Thumbing through the text, we find reference to 'dumping grounds,' 'freight yards' and 'old cellars,' showing that no plant habitat was overlooked. Particularly impressive is the coverage of Gramineae, Cyperaceae and Juncaceae, often more or less neglected in local lists. The study names 1394 plants for the whole area covered, 1271 of which were found within the township of Waterbury.

"Finally, there is a chapter on 'Places of Beauty and of Unusual Botanical Interest,' listing many of the rarer plants found in each, a list of 'Common Weeds of Waterbury' and one of plants found flowering in November."

Again, personal correspondence with Dr. Edgar T. Wherry of the University of Pennsylvania was cooperatively received and Dr. Wherry's appraisal of the Northampton study follows:

"The Vascular Flora of Northampton County, Pennsylvania, by Robert L. Schaeffer, Jr., is a very superior local study. It represents the outcome of eleven years of field work, which resulted in the collection of some 25,000 specimens, now filed in the herbaria of the University of Pennsylvania and the Academy of Natural Sciences of Philadelphia. Published by the author in 1949 as a paper-back book of over 700 pages, it was accepted as a Ph.D. thesis at the University of Pennsylvania.

"Over three-quarters of the work comprises an annotated systematic list of taxa, with simple keys. This is supplemented by treatments of the botanical history of the county, place names, plant geography and ecology of notable species, sources of adventives, excluded taxa and collections, and an extensive bibliography. May be purchased for four dollars from the author, now Professor of Botany at Muhlenberg College, Allentown, Pennsylvania."—J. HARRY LEHR.

BOOK REVIEWS

Plant Physiology—A Treatise. Edited by F. C. Steward. Volume II. Plants in Relation to Water and Solutes. 1–758 pp. Academic Press, Inc., 111 5th Avenue, New York 3, New York. 1959. $22.00.

Volume II is the first of six volumes planned in this series each to consist of a group of related chapters which cover a major subject matter segment of the subject.

Each chapter has been written by a recognized authority in the field and analyzes the present status of the subject matter. Pertinent references to the literature are given in each subject matter area. In the words of the Editor found in the Preface to Vol. II "The aim of this treatise—is to say what Plant Physiology is about and to do this in sufficient detail and with sufficient analysis of, and even extracts from, the ever expanding literature, so that each volume will be in large measure self-contained."

"This treatise is . . . designed for the use of advanced and post graduate students, teachers, research workers, and investigators in other fields of knowledge who need information about the present status of plant physiology."

"The treatise is intended not solely for use as a work of reference but is to be used by those who wish to obtain a reasoned analysis of the status and development of each subject which is discussed. Admittedly and rightly each chapter is affected by the

author's own opinions, but so far as possible in a work of this kind, an attempt has been made to achieve a measure of integration between the different chapters. The chief emphasis is a synthesis of current knowledge.

"Plant physiologists will find that the treatment is sufficiently detailed to benefit their research in their specialized fields. Indexes enable information to be treated by reference to an author's name, to the plants used, or to the subject matter in question."

As an illustration of the organization of each volume in the series, the chapters in volume two with their authors are as follows:

Chapter One—Cell Membranes: Their Resistance to Penetration and Their Capacity for Transport. By Runar Collander, Helsingfors Universitets, Botaniska Institution, Helsinki, Finland.

Chapter Two—Water Relations of Cells. By T. A. Bennet-Clark, Department of Botany, King's College, University of London.

Chapter Three—The Water Relations of Stomatal Cells and the Mechanisms of Stomatal Movement. By O. V. S. Heath, Imperial College of Science and Technology, Research Institute of Plant Physiology, Royal College of Science, London.

Chapter Four—Plants in Relation to Inorganic Solutes. By F. C. Steward, Dept. of Botany, Cornell University and J. F. Sutcliffe, Dept. of Botany, King's College, University of London.

Chapter Five—Translocation of Organic Solutes. By C. A. Swanson, Dept. of Botany, Ohio State University.

Chapter Six—Translocation of Inorganic Solutes. By O. Biddulph, Dept. of Botany, State College of Washington.

Chapter Seven—Transpiration and the Water Economy of Plants. By Paul J. Kramer, Dept. of Botany, Duke University.

These authors are leaders and at the frontiers of research in their respective fields. Those with various interests in plant science including horticulturists, and agronomists in addition to plant physiologists, plant pathologists, and other botanists will find in this treatise authoritative treatment of questions in plant physiology of interest and profit.

The titles of the other volumes in the series are as follows:

Volume	I A	Cellular Organization and Respiration
Volume	I B	Photosynthesis and Chemosynthesis
Volume	III	Inorganic Nutrition of Plants
Volume	IV	Organic Nutrition and Metabolism
Volume	V	Analysis of Growth
Volume	VI	The Physiology of Development

This treatise is planned on a scale not heretofore readily available to American readers and at a cost considerably less than the Encyclopedia of Plant Physiology currently appearing which is substantially written in German as well as English. The entire series of volumes should be a welcome addition to institutional and personal library sources of information on the field of Plant Physiology.—W. REI ROBBINS, Rutgers, The State University of New Jersey.

Anatomy of Seed Plants. By Katherine Esau. xvi + 376 pp. John Wiley & Sons, Inc., New York. 1960. $6.95.

For a long time plant anatomy has needed a new undergraduate textbook. Since the publication of Dr. Esau's book *Plant Anatomy* in 1953, many teachers have hoped that she might write such a book. Dr. Esau is the logical author, as she has made many important original contributions to piant anatomy, and her textbook is an outstanding reference. Those who knew she was writing a new book have been anxiously awaiting its appearance. Those who only expected a shorter version of *Plant Anatomy* will be surprised, for everything about this book seems new.

Anatomy of Seed Plants is generously illustrated. Almost all of the illustrations are new, and only a few are taken from her former book. This is most remarkable, considering its wealth of splendid illustrations. Frequent references to the illustrations make them a useful, integral part of the book. All are unusually clear, instructive, well-labeled, and artistically satisfying.

The reason for the freshness and newness of this book becomes apparent after studying the references. Most of the references have appeared since the publication of *Plant Anatomy* in 1953; thus, the new book reflects much of the more recent writings and thinking. *Anatomy of Seed Plants*, although intended primarily to be a concise, undergraduate textbook, should also be regarded as a companion volume to *Plant Anatomy*.

Of special interest is the glossary which has been added to this book. Dr. Esau is an outstanding authority on the historical use of terminology in plant anatomy. The glossary will be useful to all students of plant anatomy, and authors can be expected to refer to it freely.

The organization of this book differs slightly from that of *Plant Anatomy*, and the new book is about half its size. Some of the reduction in size has been made possible by restricting the subject to seed plants and by combining some of the chapters. The two long chapters on the protoplast and the cell wall at the beginning of the older book have been condensed and included under the chapter on parenchyma. The material on meristems has been rewritten and included in the appropriate chapters. Following the introduction two new chapters have been added. The first describes the development of the monocot and dicot embryos; and the second, the development of the adult plant from the embryo. Considering our present knowledge, these chapters are well written, and they help to emphasize our lack of knowledge in this area. Next, each of the plant tissues is described. The last half of the book describes the histology and development of the plant organs, beginning with the root. These chapters are especially interesting, because they contain so much of the recent work on developmental anatomy.

To accompany this book Dr. Esau has prepared a *Laboratory Guide in Plant Anatomy* which many instructors will find useful. It is arranged into 13 topics and consists of 32 closely typed pages which are crammed with instructions, questions, references, and suggestions for materials and methods. This guide gives the instructor a wide choice of materials for each topic and permits him to use his own methods of teaching.

Anatomy of Seed Plants is a valuable contribution to the teaching of plant anatomy, and will stimulate interest in anatomy. This book is recommended for the undergraduate student, and anyone else who wishes to familiarize himself with the recent literature in anatomy.—CONRAD F. MEYER.

Principles of Paleobotany, 2nd ed. By William C. Darrah. 1–295 pp. The Ronald Press Co., New York. 1960. $6.50.

Compared with Darrah's first edition (1939), the volume was shortened by one third or 146 pages. Considering the severe criticism regarding irrelevancies, inaccuracies, inconsistencies, and lack of proper credit to some source material that the first edition received, the relative brevity of the second edition is to be welcomed. As an elementary text for students in palaeobotany it is now less cumbersome, has gained in stature and content, although it still lacks much of the most recent advancement in this science.

The content follows a conventional arrangement of discussions on principles, history, techniques, the early plant record through Cenozoic floras, the origin of the existing flora, pollen analysis, evolution and phylogeny. Randomly selected shortcomings of the first edition are mostly eliminated, but a few glaring errors have remained. Consistency in proper presentation in Tables 2–5 of age relationships for geologic sequence, cultural and historical changes, sequence of floras or sequence of genera and species within a time period, should have been maintained in that it is customary to place the earliest (oldest) events on the bottom as was properly done in Tables 1 and 10–12.

While the chapter on pollen analysis, if short, is a welcome addition, the chapter

on Tertiary palaeobotany should not have been cut from 12 to 8 pages, but rather expanded. From a strictly evolutionary and taxonomic point of view, and closely relating to our modern flora, the vast accumulations of Tertiary plants, the great number of regional distinct, epochal floras, offer a far reaching opportunity for the interpretation of ancient climates, migration, evolution, and ecology. In order to stimulate prospective students, these aspects of the Tertiary ought to be a major concern of a text. Classical work in this respect by R. W. Chaney, E. Dorf, and D. I. Axelrod is negligibly treated if not ignored. A bibliography, usually indicative of the thoroughness in research, should be extensive since the prospective reader and student must be given not only a choice, but an overview of the field as a whole. In this respect a short chapter on the prevailing journals and other literature dealing with palaeobotanical aspects would have been appropriate. Many important works were apparently not consulted, or are, at least, not cited. One of these books, without which basic progress in modern palaeobotany is greatly hampered, is Oliver LaMotte's "Catalogue of Cenozoic plants of North America through 1950." This work saves untold time and effort in preparing the foundation for all palaeobotanical research, namely identification and correlation of specimens upon which the interpretation of Tertiary events is based.

Generally speaking the book is superior to its first edition, but appears to lack a certain thoroughness and the infallible competence that is expected in a text. One cannot but help compare the book with a similar text by Chester A. Arnold (1947) of which a second edition is forthcoming in the near future. In all probability Arnold's revised edition will remain the leading text in this country.—HERMAN F. BECKER.

Tree Maintenance. By P. P. Pirone. xvii + 483 pages. Fig. 1–148. Oxford University Press, New York. 1959. $10.00.

Two factors have conspired to make desirable a better understanding of the problems of shade tree care. First, the enormous increase in tree planting necessary to keep pace with expanding real-estate developments. Second, the increase in age of established trees, bringing with it problems peculiar to older trees. The present volume is a response to these needs.

The first edition of this work appeared in 1941 under the title "Maintenance of Shade and Ornamental Trees." The present volume is a third edition, revised and brought up to date. The text covers the entire field of tree maintenance from planting to the treatment of defects and decay in senile individuals nearing the end of their life span, including insect and disease recognition and control.

The work reflects the long career of the author as a diagnostician of tree disorders and personal experiences are liberally distributed throughout the book. The chapter on diagnosing tree trouble is a practical explanation of the author's methods of analyzing tree problems, with descriptions and illustrations of tools essential for the work.

The inclusion as an appendix of the methods of evaluating shade trees which was developed by the National Shade Tree Conference and the National Arborists Association will be found useful, particularly the accompanying tables listing trees according to their desirability when grown in various geographic regions. The extensive and well-selected list of references to literature is a valuable feature. The text is well illustrated by many original pictures, which are much improved in quality as compared to the second edition.

Those using the book primarily for reference may find somewhat confusing the arrangement separating "Low-Growing Trees," from "Tall-Growing Trees," where ash, maple and birch are classed as low-growing while alder is found in the tall-growing list. Moreover, the segregation of all the evergreens, both short and tall, into a third category does little to improve the situation. The treatment of the highly controversial subject of gas injury to trees could be improved by the inclusion of more adequate data.

The book has been written in such a way as to serve both as a text and a reference work. It has been used successfully in college classes and has found a welcome place in the working library of the practicing arborist. Gardeners and home owners will find in its pages the answers to many of their pressing questions.—D. S. WELCH. Cornell University.

Excursion Flora of the British Isles. By A. R. Clapham, T. G. Tutin and E. F. Warburg. i–xxiii, 1–579. Cambridge Univ. Press. 22 May 1959. $4.50.

The name "excursion flora" harks back to days when botany and classes in botany were more popular than they are now, and when students and amateurs were not dismayed by technical keys and descriptions. This little book is not in the general sense a "popular" work, a painless guide to the wildflowers. It is a condensed version of the *Flora of the British Isles* by the same authors. The purpose of the condensation was to provide a more portable and less expensive book for students. The style remains that of the larger work, which argues some differences in intellectual attitude between Britain and the United States. There are some changes in detail. Rare species, certain types of information (e.g. chromosome numbers), and illustrations are omitted, and descriptions are shorter. Certain nomenclatural and taxonomic changes have been made; these will be incorporated in a forthcoming second edition of the *Flora*.—H. W. RICKETT.

BULLETIN OF THE TORREY BOTANICAL CLUB

VOL. 87, No. 4. pp. 290–301 JULY, 1960

INDEX TO AMERICAN BOTANICAL LITERATURE

COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF BRITTONIA

TAXONOMY, PHYLOGENY AND FLORISTICS

ALGAE

Almodovar, Luis R. & Blomquist, Hugo L. The benthic algae of Bahia Fosforescente, Puerto Rico. Quart. Jour. Fla. Acad. **22**: 163–168. Sep 1959 [Jan 1960].

Daily, Fay Kenoyer. Some observations on the occurrence and distribution of the Characeae of Indiana. Proc. Indiana Acad. **68**: 95–107. 1959.

Moreira Filho, Hermes. Diatomáceas do Paraná. I. A flora diatomológica na *Sargassum*. Bol. Inst. Hist. Nat. Paraná Bot. **2**: 1–18. *pl. 1–3*. Nov 1959.

Phillips, Ronald C. Notes on the marine flora of the Marquesas Keys, Florida. Quart. Jour. Fla. Acad. **22**: 155–162. Sep 1959 [Jan 1960].

Reimer, Charles W. The diatom genus *Neidium*. I. New species, new records, and taxonomic revisions. Proc. Acad. Phila. **91**: 1–35. *pl. 1–4*. 29 Mai 1959.

Silva, Paul C. Remarks on algal nomenclature. III. Taxon **9**: 18–25. 14 Jan 1960.

BRYOPHYTES

Clark, Lois. *Frullania tenera*. Bryologist **62**: 190–193. 1959 [9 Feb 1960].

Crum, Howard. A small collection of West Javanese mosses. Bryologist **62**: 188–190. 1959 [9 Feb 1960].

Fulford, Margaret. Studies on American Hepaticae. 9. A supplement to "The genus *Bazzania* in Central and South America." II. *Tridentatae* (3). Bull. Torrey Club **86**: 394–412. 23 Dec 1959.

Pursell, A. A. & Sharp, A. J. Noteworthy mosses from Alabama and Tennessee. Castanea **24**: 147, 148. Dec 1959.

Redfearn, Paul L. Notes on the bryophytes of southwest Missouri. II. Fruiting *Amblystegium laxirete*. Bryologist **62**: 179–181. 1959 [9 Feb 1960].

Reese, William D. *Syrrhopodon parasiticus* in the southern United States. Bryologist **62**: 182–186. 1959 [9 Feb 1960].

Robinson, Harold. The status of *Calliergon subsarmentosum*. Bryologist **62**: 186–188. 1959 [9 Feb 1960].

Schuster, Rudolf M. A monograph of the nearctic Plagiochilaceae. Part III. Sectio *Contiguae* to conclusion. Am. Midl. Nat. **63**: 1–130. Jan 1960.

Svihla, Ruth D. The female inflorescence of *Frullania picta*. Bryologist **62**: 193–195. 1959 [9 Feb 1960].

Welch, Winona H. & Crum, Howard. A contribution to the Jamaican moss flora. Bryologist **62**: 165–179. 1959 [9 Feb 1960].

FUNGI

* (See also under Morphology: **Alexopoulos**; under Plant Physiology: **Barksdale**)

Al-Doory, Yousef. Myxomycetes from Iraq. Mycologia **51**: 299, 300. Mar–Apr [Nov] 1959.

Al-Doory, Yousef, Tolba, M. K. & Al-Ani, H. On the fungal flora of Iraqi soils. II. Central Iraq. Mycologia **51**: 429–431. Mai–Jun [Dec] 1959.

Bakerspigel, Alexander. Nuclear structure and division in the vegetative mycelium of the Saprolegniaceae. Am. Jour. Bot. **47**: 94–100. 19 Feb 1960.

Batra, Lekh R. A comparative morphological and physiological study of the species of *Dipodascus*. Mycologia **51**: 329–355. Mai–Jun [Dec] 1959.

Baxter, John W. A monograph of the genus *Uropyxis*. Mycologia **51**: 210–226. Mar–Apr [Nov] 1959.

Cummins, George B. Descriptions of tropical rusts—IX. Bull. Torrey Club **87**: 31–45. 16 Feb 1960.

Edmunds, L. K. & Hanson, E. W. Host range, pathogenicity and taxonomy of *Ascochyta imperfecta*. Phytopathology **50**: 105–108. 20 Feb 1960.

Ellingboe, Albert H. A comparative study of the fungi causing the spring blackstem disease of alfalfa and red clover [*Phoma herbarum* var. *medicaginis*]. Phytopathology **49**: 764–770. 30 Nov 1959.

Emmons, Chester W. Fungus nuclei in the diagnosis of mycoses. Mycologia **51**: 227–236. Mar–Apr [Nov] 1959.

Fennell, Dorothy I. & Warcup, J. H. The ascocarps of *Aspergillus alliaceus*. Mycologia **51**: 409–415. Mai–Jun [Dec] 1959.

Galindo, A. J. & Gallegly, M. E. The nature of sexuality in *Phytophthora infestans*. Phytopathology **50**: 123–128. 20 Feb 1960.

Gillis, William T. Subterranean *Elaphomyces* and *Rhizopogon* in the Michigan jack-pine region. Mycologia **51**: 364–367. Mai–Jun [Dec] 1959.

Guzmán H., Gastón. Sinopsis de los conocimientos sobre los hongos alucinógenos mexicanos. Bol. Soc. Bot. Méx. **24**: 14–34. Nov 1959.

Hesseltine, C. W. *Gilbertella* gen. nov. (Mucorales). Bull. Torrey Club **87**: 21–30. 16 Feb 1960.

Hesseltine, C. W., Benjamin, C. R. & Mehrota, B. S. The genus *Zygorhynchus*. Mycologia **51**: 173–194. Mar–Apr [Nov] 1959.

Jackson, Curtis R. Soil fungi from *Chrysanthemum* plantings. Quart. Jour. Fla. Acad. **22**: 147–154. Sep 1959 [Jan 1960].

Jackson, Curtis R. & Weber, George F. Morphology and taxonomy of *Alternaria cucumerina*. Mycologia **51**: 401–408. Mai–Jun [Dec] 1959.

Korf, Richard P. Nomenclatural notes. III. *Chlorociboria* vs. *Piceomphale*. Mycologia **51**: 298, 299. Mar–Apr [Nov] 1959.

Littrell, E. S. & Rogerson, Clark T. Homothallism in an undescribed species of *Cochliobolus* [*homomorphus*] and in *Cochliobolus kusanoi*. Mycologia **51**: 195–202. Mar–Apr [Nov] 1959.

McKay, Hazel H. Cultural basis for maintaining *Polyporus cinnabarinus* and *Polyporus sanguineus* as two distinct species. Mycologia **51**: 465–473. Mai–Jun [Dec] 1959.

Martin, G. W. The starting point for fungi. Taxon **9**: 1–3. 14 Jan 1960.

Martin, G. W., Thind, K. S. & Rehill, P. S. The Myxomycetes of the Mussoorie hills (India). X. [2 spp. nov.] Mycologia **51**: 159–162. Mar–Apr [Nov] 1959.

Miller, Charles E. Studies on the life cycle and taxonomy of *Ligniera verrucosa*. Am. Jour. Bot. **46**: 725–729. 19 Dec 1959.

Moore, R. T. *Scheleobrachea* Hughes [*Piricauda scorobylos*, sp. nov.]. Mycologia **51**: 300–302. Mar–Apr [Nov] 1959.

Nelson, R. R. *Cochliobolus carbonum*, the perfect stage of *Helminthosporium carbonum*. Phytopathology **49**: 807–810. Dec 1959 [6 Jan 1960].

Olive, Lindsay S. & Stoianovitch, Carmen. Two new members of the Acrasiales. Bull. Torrey Club **87**: 1–20. 16 Feb 1960.

Orr, G. F. & Plunkett, O. A. A new species of *Absidia* [*cuneospora*] from California. Mycologia **51**: 203–209. Mar–Apr [Nov] 1959.

Pantidou, Maria E. *Claviceps* from *Zizania*. Canad. Jour. Bot. **37**: 1233–1236. *pl. 1*. Nov 1959.

Peterson, John E. New species of Myxobacteria from the bark of living trees. Mycologia **51**: 163–172. Mar–Apr [Nov] 1959.

Raper, John R. Sexual versatility and evolutionary processes in fungi. Mycologia **51**: 107–124. Mar-Apr [Nov] 1959.

Sarkar, Anjali. Studies in wood-inhabiting Hymenomycetes. IV. The genus *Coriolellus* Murr. Canad. Jour. Bot. **37**: 1251–1270. *pl. 1, 2*. Nov 1959.

Singer, Rolf. New and interesting species of Basidiomycetes. VI. Mycologia **51**: 375–400. Mai–Jun [Dec] 1959.

Singer, Rolf. Persoon's Synopsis 1801 as starting point for all fungi? Taxon **9**: 35–37. 25 Feb 1960.

Singer, Rolf & Smith, Alexander H. Studies on secotiaceous fungi—V. *Nivatogastrium* gen. nov. Brittonia **11**: 224–228. *pl. 3*. 26 Oct 1959.

Singer, Rolf & Smith, Alexander H. Studies on secotiaceous fungi—VII. *Secotium* and *Neosecotium*. Madroño **15**: 152–158. 29 Jan 1960.

Smith, Alexander H. *Tricholomopsis* (Agaricales) in the Western Hemisphere. Brittonia **12**: 41–70. *pl. 1–7*. 30 Jan 1960.

Smith, Alexander H. & Singer, Rolf. Studies on secotiaceous fungi—IV. *Truncocolumella* and *Chamonixia*. Brittonia **11**: 205–223. *pl. 1, 2*. 26 Oct 1959.

Sprague, Roderick & Lawrence, Donald B. The fungi on deglaciated Alaskan terrain of known age. II. Res. Stud. Wash. St. Univ. **27**: 215–229. Dec 1959. III. **28**: 1–20. Mar 1960.

Thind, K. S., Cash, Edith K. & Singh, Pritam. The Pezizaceae of the Mussourie Hills (India)—VII. Mycologia **51**: 457–464. Mai–Jun [Dec] 1959.

Van Denack, *Sister* Julia Marie & Harison, Herbert C. The *Danthonia*-lichen-moss community in Washington, D. C., and vicinity. Jour. Wash. Acad. **49**: 367–371. Dec 1959.

PTERIDOPHYTES

Howell, J. T. *Selaginella Bigelovii* not on Mt. Tamalpais, California. Leafl. West. Bot. **9**: 69, 70. 11 Dec 1959.

Morton, C. V. The correct name of the fern usually called *Alsophila blechnoides*. Am. Fern Jour. **49**: 151–153. Dec 1959.

Morton, C. V. The Machris Brazilian Expedition. Botany: Pteridophyta. Los Angeles Mus. Contr. Sci. **35**: 1–7. 20 Jan 1960.

Proctor, George R. New combinations in *Thelypteris*. Rhodora **61**: 305, 306. Dec 1959 [19 Jan 1960].

Stokey, Alma G. *Polypodium pectinatum* and *P. plumula*—Polypodiaceae or Grammitidaceae? Am. Fern Jour. **49**: 142–146. Dec 1959.

Stone, Benjamin C. & Lane, Irwin E. On a small collection of ferns from the New Hebrides and the Solomon Islands. Bot. Not. **112**: 372–376. 1959.

Tryon, Rolla. New species of ferns from Central and South America. Rhodora **62**: 1–10. Jan 1960.

Tryon, Rolla & Tryon, Alice. Observations on cultivated ferns: the hardy species of tree ferns (*Dicksonia* and Cyatheaceae). Am. Fern Jour. **49**: 129–142. Dec 1959.

Wilson, Kenneth A. The sporangia of three problematic species of *Polypodium*. Am. Fern Jour. **49**: 147–151. Dec 1959.

SPERMATOPHYTES

(See also under Morphology: **Boke**)

Aristeguieta, Leandro & Matos, Felipe. Estudios dendrológicos en el Bosque de los Guayabitos. Bol. Soc. Venez. Ci. Nat. **21**[95]: 16–62. Dec 1959.

Ashri, Amram & Knowles, P. F. Cytogenetics of safflower (*Carthamus* L.) species and their hybrids. Agron. Jour. **52**: 11–17. Jan 1960.

Bell, C. Ritchie & Constance, Lincoln. Chromosome numbers in Umbelliferae. II. Am. Jour. Bot. **47**: 24–32. 28 Jan 1960.

Brown, J. R. Notes on haworthias. Cact. Succ. Jour. **32**: 26–28. Jan 1960.

Crampton, Beecher. The grass genera *Orcuttia* and *Neostapfia;* A study in habitat and morphological specialization [*O. mucronata*, sp. nov.]. Madroño **15**: 97–110. Oct 1959.

De Laubenfels, D. J. *Podocarpus lucienii*, a new species from New Caledonia. Brittonia **12**: 79, 70. 30 Jan 1960.

De Wet, J. M. J. Chromosome numbers and some morphological attributes of various South African grasses. Am. Jour. Bot. **47**: 44–49. 28 Jan 1960.

Drapalik, Donald J. & Mohlenbrock, Robert H. The taxonomic status of *Eleocharis elliptica*. Am. Midl. Nat. **63**: 143–148. Jan 1960.

Ferris, Roxana Stinchfield. Illustrated flora of the Pacific States; Washington, Oregon and California. **4**: Bignoniaceae to Compositae. 1–732. 1960.

Gross, A. T. H. Distribution and cytology of *Elymus macounii* Vasey. Canad. Jour. Bot. **38**: 63–67. *pl. 1.* Jan 1960.

Hardin, James W. Studies in the Hippocastanaceae, V. Species of the Old World. Brittonia **12**: 26–38. 30 Jan 1960.

Hermann, F. J. An Andean and a Californian sedge in Arizona. Leafl. West. Bot. **9**: 86, 87. 29 Feb 1960.

Hermann, F. J. Two new varieties of *Carex* from Mexico. Brittonia **12**: 78, 79. 30 Jan 1960.

Howell, John Thomas. A Mexican pokeberry in San Francisco, California. Leafl. West. Bot. **9**: 81–83. 29 Feb 1960.

Hu, Shiu-ying. A monograph of the genus *Paulownia*. Quart. Jour. Taiwan Mus. **12**: 1–54. 1959.

Hu, Shiu-ying. Chinese hollies. Tsing Hua Jour. Chinese Studies. Spec. Numb. Nat. Sci. **1**: 150–184. 1959.

Jackson, R. C. Additions to the flora of New Mexico. Leafl. West. Bot. **9**: 85, 86. 29 Feb 1960.

Küchler, A. W. Vergleichende Vegetationskartierung. Vegetatio **9**: 208–216. 30 Jan 1960.

Kuijt, Job. The distribution of dwarf mistletoes, *Arceuthobium*, in California. Madroño **15**: 129–139. 29 Jan 1960.

Landry, Pierre. Additions à la flore des environs du Lac Saint-Jean. Nat. Canad. **86**: 129–131. Jun 1959.

Langman, Ida K. *Castilla* Sessé, not *Castilla* Cerv. Brittonia **12** (Tax. Index **23**): viii. 30 Jan 1960.

Lehr, J. Harry. Additions and corrections to a Flora of Rockland County, New York. Bull. Torrey Club **87**: 59–61. 16 Feb 1960.

Leonard, E. C. Five new species and one variety of Acanthaceae recently collected in Venezuela. Bol. Soc. Venez. Ci. Nat. **21**[95]: 7–15. Dec 1959.

Manning, Wayne E. The genus *Juglans* in South America and the West Indies. Brittonia **12**: 1–26. 30 Jan 1960.

Markarian, D. & Olmo, H. P. Cytogenetics of *Rubus*. I. Reproductive behavior of *R. procerus* Muell. Jour. Hered. **50**: 131–136. Mai–Jun [Nov] 1959.

Mason, Charles T. Notes on the flora of Arizona II. Leafl. West. Bot. **9**: 87, 88. 29 Feb 1960.

Ornduff, Robert. Pappus dimorphism in *Crocidium multicaule* Hook. Leafl. West. Bot. **9**: 84, 85. 29 Feb 1959.

Pacit, J. The "classes" of Rafinesque and the modern systematics. Taxon **9**: 47–49. Feb 1960.

Raven, Peter H. Notes on the plants of the 1955 Refugio Pass burn, Santa Barbara County, California. Leafl. West. Bot. **9**: 79–81. 29 Feb 1960.

Raven, Peter H. & Lewis, Harlan. The relationship of clarkias from two continents. Brittonia **11**: 193–205. 26 Oct 1959.

Raven, Peter H., Solbrig, Otto T., Kyhos, Donald W. & Snow, Richard. Chromosome numbers in Compositae. I. Astereae. Am. Jour. Bot. **47**: 124–132. 19 Feb 1960.

Reeder, John R. & Ellington, Margaret A. *Calamovilfa*, a misplaced genus of Gramineae. Brittonia **12**: 71–77. 30 Jan 1960.

Rollins, Reed C. Some sisymbriums (Cruciferae) native to Texas and northeastern Mexico. Rhodora **62**: 55–60. 24 Feb 1960.

Rubtzoff, Peter. Notes on fresh-water marsh and aquatic plants in California—I. Leafl. West. Bot. **9**: 73–78. 29 Feb 1960.

Solbrig, Otto T. The status of the genera *Amphipappus, Amphiachyris, Greenella, Gutierrezia, Gymnosperma* and *Xanthocephalum* (Compositae). Rhodora **62**: 43–54. 24 Feb 1960.

Soukup, J. Los géneros de las monocotiledóneas peruanas. Biota **2**: 55–68. Mai. 73–84. Oct. 121–135. Dec 1958. 153–178. Mai. 223–237. Jun 1959.

Vogelmann, H. W. Chromosome numbers in some American farinose primulas with comments on their taxonomy. Rhodora **62**: 31–49. 24 Feb 1960.

Waisel, Yoav. Ecotypic variation in *Nigella arvensis* L. Evolution **13**: 469–475. Dec 1959 [Jan 1960].

Waterman, Ann H. The mints (family Labiatae) of Michigan. Mich. St. Univ. Biol. Ser. **1**: 269–302. 2 Mai 1960.

Webster, Grady L. The status of *Agyneia* and *Glochidion* (Euphorbiaceae). Taxon **9**: 25, 26. Jan 1960.

Wells, Philip V. Variation in section *Trigonophyllae* of *Nicotiana*. Madroño **15**: 148–151. 29 Jan 1960.

Yuncker, T. G. Piperaceae of Micronesia. Occ. Pap. Bishop Mus. **22**: 83–108. 27 Feb 1959.

PALEOBOTANY

Baxter, Robert W. The sporangium of *Cystosporites varius*. Trans. Kan. Acad. **62**: 47–52. 1959.

Beck, Charles B. Studies of New Albany shale plants. I. *Stenokoleos simplex* comb. nov. Am. Jour. Bot. **47**: 115–124. 19 Feb 1960.

Becker, Herman F. Epitaph? to *Eopuntia douglasii*. Cact. Succ. Jour. **32**: 28, 29. Jan 1960.

Becker, Herman F. A new species of *Mahonia* from the Oligocene Ruby flora of southwestern Montana. Contr. Mus. Paleont. Univ. Mich. **15**: 33–38. 2 Oct 1959.

Gridland, Arthur A. A new species of *Arthroxylon* [*resinaceum*] (Calamitaceae) from the Pennsylvanian of Kansas. Am. Jour. Bot. **46**: 709–712. 19 Dec 1959.

Delevoryas, Theodore. Investigations of North American cycadeoids: *Monanthesia*. Am. Jour. Bot. **46**: 657–666. Nov 1959.

Kaplan, L. & MacNeish, R. S. Prehistoric bean remains from caves in the Ocampo region of Tamaulipas, Mexico. Bot. Mus. Leafl. **19**: 33–57. *pl. 6, 7.* 27 Jan 1960.

ECOLOGY AND PLANT GEOGRAPHY

(See also under Spermatophytes: **Crampton**)

Anderson, John W. A study of pseudonanism in *Pinus rigida* Mill. Ecol. Monogr. **29**: 309–332. Oct 1959.

Bormann, F. H. & Graham, Benn F. The occurrence of natural root grafting in eastern white pine, *Pinus strobus* L., and its ecological implications. Ecology **40**: 678–691. Oct 1959.

Buell, Murray F. & Facey, Vera. Forest-prairie transition west of Itasca Park, Minnesota. Bull. Torrey Club **87**: 46–58. 16 Feb 1960.

Cook, C. Wayne, Stoddard, L. A. & Harris, Lorin E. The chemical content in various portions of the current growth of salt-desert shrubs and grasses during winter. Ecology **40**: 644–651. Oct 1959.

Cotter, David J. & Platt, Robert B. Studies on the ecological life history of *Portulaca smallii*. Ecology **40**: 651–668. Oct 1959.

Dansereau, Pierre & Arros, Jenö. Essais d'application de la dimension structurale en phytosociologie. I. Quelques exemples européens. Vegetatio **9**: 48–99. 15 Oct 1959.

Dunn, David B. Some effects of air pollution on *Lupinus* in the Los Angeles area. Ecology **40**: 621–625. Oct 1959.

Eggler, Willis A. Manner of invasion of volcanic deposits by plants with further evidence from Particutin and Jorullo. Ecol. Monogr. **29**: 268–284. Jul 1959.

Ellison, Lincoln. Influence of grazing on plant succession of rangelands. Bot. Rev. **26**: 1–78. Jan–Mar 1960.

Flaccus, Edward. Revegetation of landslides in the White Mountains of New Hampshire. Ecology **40**: 692–703. Oct 1959.

Fraser, D. A. & Dirks, H. T. Internal water relations of yellow birch at Chalk River. Canad. Jour. Bot. **37**: 789–799. Sep 1959.

Herbel, Carlton H. & Anderson, Kling L. Response of true prairie vegetation on major Flint Hills range sites to grazing treatments. Ecol. Monogr. **29**: 171–186. Apr 1959.

Hutchings, Selar S. & Holmgren, Ralph C. Interpretation of loop-frequency data as a measure of plant cover. Ecology **40**: 668–677. Oct 1959.

Kendrick, W. Bryce. The time factor in the decomposition of coniferous leaf litter. Canad. Jour. Bot. **37**: 907–912. Sep 1959.

Kohn, Alan J. The ecology of Cornus in Hawaii. Ecol. Monogr. **29**: 47–90. Jan. 1959.

McMillan, Calvin. The role of ecotypic variation in the distribution of the central grassland of North America. Ecol. Monogr. **29**: 285–308. Oct 1959.

Martin, N. D. An analysis of forest succession in Algonquin Park, Ontario. Ecol. Monogr. **29**: 187–218. Jul 1959.

Martin, William E. The vegetation of Island Beach State Park, N. J. Ecol. Monogr. **29**: 1–46. Jan 1959.

Morello, Jorge. La provínceia fitogeográfica del monte. Opera Lilloana **2**: 1–155. *pl. 1–68.* 1958.

Rice, Elroy L. & Penfound, Wm. T. The upland forests of Oklahoma. Ecology **40**: 593–608. Oct 1959.

Ritchie, Don. The effect of salinity and temperature on marine and other fungi from various climates. Bull. Torrey Club **86**: 367–373. Dec 1959.

Small, John A. Skunk cabbage, *Symplocarpus foetidus.* Bull. Torrey Club **86**: 413–416. 23 Dec 1959.

Smith, Dixie R. Description and response to elk use of two mesic grassland and shrub communities in the Jackson Hole region of Wyoming. Northw. Sci. **34**: 25–36. Feb 1960.

Taylor, B. W. The classification of lowland swamp communities in northeastern Papua. Ecology **40**: 703–712. Oct 1959.

To Strake, Diane. Estuarine distribution and saline tolerance of some Saprolegniaceae. Phyton Buenos Aires **12**: 147–152. Jul 1959.

Vaartaja, O. Evidence of photopheriodic ecotypes in trees. Ecol. Monogr. **29**: 91–111. Apr 1959.

Verduin, Jacob. Photosynthesis by aquatic communities in northwestern Ohio. Ecology **40**: 377–383. Jul 1959.

Wells, Phlipi V. An ecological investigation of two desert tobaccos. Ecology **40**: 626–644. Oct 1959.

MORPHOLOGY

(including anatomy and cytology in part)
(See also under Fungi: **Emmons**)

Alexopoulos, Constantine J. Morphology and laboratory cultivation of *Echinostelium minutum.* Am. Jour. Bot. **47**: 37–43. 28 Jan 1960.

Boke, Norman H. Anatomy and development in *Solisia.* Am. Jour. Bot. **47**: 59–65. 28 Jan 1960.

Canright, James E. The comparative morphology and relationships of the Magnoliaceae. III. Carpels. Am. Jour. Bot. **47**: 145–155. 19 Feb 1960.

Stein, Diana B. & Stein, Otto L. The growth of the stem tip of *Kalanchoë* cv. 'Brilliant Star.' Am. Jour. Bot. **47**: 132–140. 19 Feb 1960.

Stern, William L. & Chambers, Kenton L. The citation of wood specimens and herbarium vouchers in anatomical research. Taxon **9**: 7–13. 14 Jan 1960.

Stone, Donald E. Nuclear cytology of the California mouse-tails (*Myosurus*), Madroño **15**: 139–148. 29 Jan 1960.

Winter, Dorothy M. The development of the seed of *Abutilon theophrasti.* I. Ovule and embryo. Am. Jour. Bot. **47**: 8–14. 28 Jan. II. Seed coat. 157–162. 21 Mar 1960.

PLANT PHYSIOLOGY

(See also under Ecology and Plant Geography: **Verduin**)

Al-Talib, Khalil H. & Torrey, John G. The aseptic culture of isolated buds of *Pseudotsuga taxifolia.* Pl. Physiol. **34**: 630–637. Nov [Dec] 1959.

Bar-Akiva, A. & Hewitt, E. J. The effects of triiodobenzoic acid and urea on the response of chlorotic lemon (*Citrus limonia*) trees to foliar application of iron compounds. Pl. Physiol. **34**: 641, 642. Nov [Dec] 1959.

Barksdale, Alma Whiffen. Inter-thallic sexual reactions in *Achlya*, a genus of the aquatic fungi. Am. Jour. Bot. **47**: 14–23. 28 Jan 1960.

Brandt, W. H. & Wang, C. H. Catabolism of C^{14}-labelled glucose, gluconate and acetate in *Verticillium albo-atrum*. Am. Jour. Bot. **47**: 50–53. 28 Jan 1960.

Calvert, Oscar H., Williams, Leonard F. & Whitehead, Marvin D. Frozen lima-bean agar for culture and storage of *Phytophthora sojae*. Phytopathology **50**: 136, 137. 20 Feb 1960.

Corns, W. G. Effects of gibberellin treatments on germination of various species of weed seeds. Canad. Jour. Pl. Sci. **40**: 47–51. Jan 1960.

Crafts, A. S. Further studies on comparative mobility of labeled herbicides. Pl. Physiol. **34**: 613–620. Nov [Dec] 1959.

Dawson, R. F. & Solt, Marie L. Estimated contributions of root and shoot to the nicotine content of the tobacco plant. Pl. Physiol. **34**: 656–661. Nov [Dec] 1959.

De Plater, C. V. & Greenham, C. G. A wide-range A. C. bridge for determining injury and death. Pl. Physiol. **34**: 661–667. Nov [Dec] 1959.

Diener, Theodor O. Free amino acids and amides in healthy and virus-infected cherry and peach leaves. Phytopathology **50**: 141–145. 20 Feb 1960.

Ellner, Paul D. An improved technique for the growth of *Chlorella* in C^{14} O_2. Pl. Physiol. **34**: 638–640. Nov [Dec] 1959.

Fennell, Dorothy I. Conservation of fungous cultures. Bot. Rev. **26**: 79–141. Jan–Mar 1960.

Gerloff, Gerald C., Stout, P. R. & Jones, L. H. P. Molybdenum-manganese-iron antagonisms in the nutrition of tomato plants. Pl. Physiol. **34**: 608–613. Nov [Dec] 1959.

Foley, D. C. The response of corn to inoculation with *Diplodia zeae* and *Gibberella zeae*. Phytopathology **50**: 146–150. 20 Feb 1960.

Fry, P. R., Grogan, R. G. & Lyttleton, J. W. Physical and chemical properties of clover mosaic virus. Phytopathology **50**: 175–177. 20 Feb 1960.

Fuller, Melvin S. & Barshad, Isaac. Chitin and cellulose in the cell walls of *Rhizidiomyces* sp. Am. Jour. Bot. **47**: 105–109. 19 Feb 1960.

Haber, Alan H. & Luippold, Helen J. Effects of gibberellin on gamma-irradiated wheat. Am. Jour. Bot. **47**: 140–144. 19 Feb 1960.

Hanson, J. B., Hageman, R. H. & Fisher, M. E. The association of carbohydrases with the mitochondria of corn scutellum. Agron. Jour. **52**: 49–52. Jan 1960.

Highkin, H. R. Effect of vernalization on heat resistance in two varieties of peas. Pl. Physiol. **34**: 643, 644. Nov. [Dec] 1959.

Higinbotham, N. The possible role of adenosin triphosphate in rubidium absorption as revealed by the influence of external phosphate, dinitrophenol and arsenate. Pl. Physiol. **34**: 645–650. Nov [Dec] 1959.

Ingold, C. T. Jelly as a water-reserve in fungi [*Bulgaria, Phallus*]. Brit. Mycol. Soc. Trans. **42**: 475–478. Dec 1959.

Kahn, J. S. & Hanson, J. B. Some observations on potassium accumulation in corn root mitochondria. Pl. Physiol. **34**: 621–631. Nov [Dec] 1959.

Kessler, B., Bak, R. & Cohen, A. Flowering in fruit trees and annual plants as affected by purines, pyrimidines and triiodobenzoic acid. Pl. Physiol. **34**: 605–608. Nov [Dec] 1959.

Lawrence, John M., Day, Katherine M. & Stephenson, Janet E. Nitrogen mobilization in pea seedlings. Pl. Physiol. **34**: 668–674. Nov [Dec] 1959.

Levitt, J. Bound water and frost hardiness. Pl. Physiol. **34**: 674–677. Nov [Dec] 1959.

Linck, J. & Sudia, Theodore W. The effect of gibberellic acid on the absorption and translocation of phosphorus–32 by bean plants. Am. Jour. Bot. **47**: 101–105. 19 Feb 1960.

Lowrings, P. H. & Acha, Isabel Garcia. Some factors affecting growth of *Phytophthora infestans* (Mont.) De Bary. Brit. Mycol. Soc. Trans. **42**: 491–501. Dec 1959.

McClendon, John H. & Somers, G. Fred. The enzymatic maceration of plant tissues: observations using a new method of measurement. Am. Jour. Bot. **47**: 1–7. 28 Jan 1960.

Passow, Hermann & Rothstein, Aser. The binding of mercury by the yeast cell in relation to changes in permeability. Jour. Gen. Physiol. **43**: 621–633. Jan 1960.

Roberts, Lorin W. Protein-bound sulfhydryl groups in *Coleus* wound meristems. Am. Jour. Bot. **47**: 110–114. 19 Feb 1960.

Romberger, John A. A soluble pyridine nucleotide oxidase system from barley roots. Pl. Physiol. **34**: 589–597. Nov [Dec] 1959.

Salisbury, Frank B. Growth regulators and flowering. II. The cobaltous ion. Pl. Physiol. **34**: 598–604. Nov [Dec] 1959.

Samborski, D. J., Person, Clayton & Forsyth, F. R. Differential effects of maleic hydrazide on the growth of leaf and stem rusts of wheat. Canad. Jour. Bot. **38**: 1–7. Jan 1960.

Sitterly, W. R. & Shay, J. R. Physiological factors affecting the onset of susceptibility of apple fruit to rotting by fungus pathogens. Phytopathology **50**: 91–93. 20 Feb 1960.

Smillie, Robert M. & Fuller, R. C. Ribulose 1,5-diphosphate carboxylase activity in relation to photosynthesis by intact leaves and isolated chloroplasts. Pl. Physiol. **34**: 651–656. Nov [Dec] 1959.

Smillie, Robert M. & Krotkov, G. The estimation of nucleic acids in some algae and higher plants. Canad. Jour. Bot. **38**: 31–49. Jan 1960.

Tape, Norman W., Cappellini, R. A. & Davis, B. H. Mode of action of nystatin on some filamentous fungi. Phytopathology **50**: 163–169. 20 Feb 1960.

Toussoun, T. A., Nash, Shirley M. & Snyder, William C. The effect of nitrogen sources and glucose on the pathogenesis of *Fusarium solani* f. *phaseoli*. Phytopathology **50**: 137–140. 20 Feb 1960.

Tsao, Peter H., Leben, Curt & Keitt, G. W. The partial purification and biological activity of an antifungal antibiotic produced by a strain of *Streptomyces griseus*. Phytopathology **50**: 169–174. 20 Feb 1960.

Yarwood, C. E. Release and preservation of virus by roots. Phytopathology **50**: 111–114. 20 Feb 1960.

PHYTOPATHOLOGY

(See also under Fungi: **Edmunds & Hanson; Ellingboe;** under Plant Physiology: **Lowrings & Acha; McClendon & Somers; Samborski et al.**)

Bancroft, J. B., Moorhead, Ellen L., Tuite, J. & Liu, H. P. The antigenic characteristics and the relationship among strains of alfalfa mosaic virus. Phytopathology **50**: 34–39. 25 Jan 1960.

Banham, F. L. Soil insecticides for control of the tuber flea beetle, *Epitrix tuberis* (Gent.), in the interior of British Columbia. Canad. Jour. Pl. Sci. **40**: 165–171. Jan 1960.

Bega, Robert V. The effect of environment on germination of sporidia in *Cronartium ribicola*. Phytopathology **50**: 61–69. 25 Jan 1960.

Burrage, R. H. Insecticide row treatments for the control of wireworms in potatoes. Canad. Jour Pl. Sci. **40**: 178–182. Jan 1960.

Cook, A. A. & Anderson, C. W. Inheritance of resistance to potato virus Y derived from two strains of *Capsicum annuum*. Phytopathology **50**: 73–75. 25 Jan 1960.

Diener, T. O. & Weaver, M. L. A wilt disease of peach and pear seedlings caused by a strain of *Penicillium funiculosum*. Phytopathology **50**: 161–163. 20 Feb 1960.

Doolittle, S. P. & Webb, R. E. A strain of cucumber virus 1 infectious to blight-resistant spinach. Phytopathology **50**: 7–9. 25 Jan 1960.

Duncan, Joseph & Généreux, Henri. La transmission par les insectes de *Corynebacterium* [*"Cornybacterium"*] *sepedonicum* (Spieck & Kott.) Skaptason et Burkholder. Canad. Jour. Pl. Sci. **40**: 110–116. Jan 1960.

Gilbertson, R. L. Studies on the western wood-rotting fungus *Poria zonata* Bres. Canad. Jour. Bot. **38**: 87–91. *pl. 1.* Jan 1960.

Jewell, F. F. Inoculation of slash pine seedlings with *Cronartium fusiforme*. Phytopathology **50**: 48–51. 25 Jan 1960.

Kendrick, E. L. & Holton, C. S. Differential longevity of teliospores of pathogenic races of *Tilletia caries* and *T. foetida*. Phytopathology **50**: 51–54. 25 Jan 1960.

Loebenstein, G. & Harpaz, I. Virus diseases of sweet potatoes in Israel. Phytopathology **50**: 100–104. 20 Feb 1960.

Ludwig, R. A., Spencer, E. Y. & Unwin, C. H. An antifungal factor from barley of possible significance in disease resistance. Canad. Jour. Bot. **38**: 21–29. *pl. 1, 2.* 25 Jan 1960.

MacLachlan, D. S. Two virus diseases of rhubarb in eastern Ontario. Canad. Jour. Pl. Sci. **40**: 104–109. *f. 1–6.* Jan 1960.

McMeekin, Dorothy. The role of the oospores of *Peronospora parasitica* in downy mildew of crucifers. Phytopathology **50**: 93–97. 20 Feb 1960.

MacNeill, Blair H. & Ismen, Hikmet. Studies on the virus-streak syndrome in tomatoes. Canad. Jour. Bot. **38**: 9–20. Jan 1960.

Maloy, Otis C. Physiology of *Fusarium solani* f. *phaseoli* in relation to saprophytic survival in soil. Phytopathology **50**: 56–61. 25 Jan 1960.

Martin, W. J. & Kantack, E. J. Control of internal cork of sweet potato by isolation. Phytopathology **50**: 150–152. 20 Feb 1960.

Martorell, Luis F. Orchid pests in Puerto Rico. Am. Orchid Soc. Bull. **29**: 117–120. Feb 1960.

Perron, J. P. & Lafrance, J. Control of onion maggot, *Hylemya antiqua* (Meig.) (Diptera: Anthomyiidae), with insecticides in organic soils of southwestern Quebec. Canad. Jour. Pl. Sci. **40**: 156–159. Jan 1960.

Raine, J. & Andison, H. Chemical control of the raspberry root borer, *Bembecia marginata* (Harr.), on loganberry in British Columbia. Canad. Jour. Pl. Sci. **40**: 160–164. *f. 1.* Jan 1960.

Roane, C. W. *et al.* Survival of physiologic races of *Puccinia graminis* var. *tritici* on wheat near barberry bushes. Phytopathology **50**: 40–44. 25 Jan 1960.

Schlegel, David E. Transmission of several plant viruses by phenol-water extracts of diseased tissues. Phytopathology **50**: 156–158. 20 Feb 1960.

Segall, R. H. & Newhall, A. G. Onion blast or leaf spotting caused by species of *Botrytis*. Phytopathology **50**: 76–82. 25 Jan 1960.

Shepherd, Robert J. & Pound, Glenn S. Influence of boron nutrition of *Nicotiana tabacum* on the multiplication of tobacco mosaic virus. Phytopathology **50**: 26–30. 25 Jan 1960.

Sher, S. A. A root-lesion nematode disease of *Cymbidium* orchids. Am. Orchid Soc. Bull. **29**: 94–97. Feb 1960.

Silverman, William. The development of stem rust on wheat leaves treated with some sugars and sugar alcohols. Phytopathology **50**: 114–119. 20 Feb 1960.

Silverman, William. A toxin extracted from Marquis wheat infected by race 38 of the stem rust fungus. Phytopathology **50**: 130–136. 20 Feb 1960.

Simmonds, P. M. Infection of wheat with *Helminthosporium sativum* in relation to the nitrogen content of the plant tissues. Canad. Jour. Pl. Sci. **40**: 139–145. Jan 1960.

Simons, John M. Effects of foliar sprays of cytovirin on susceptibility to and transmissibility of potato virus Y in pepper. Phytopathology **50**: 109–111. 20 Feb 1960.

Smith A. L. & Dick, J. B. Inheritance of resistance to *Fusarium* wilt in upland and sea island cottons as complicated by nematodes under field conditions. Phytopathology **50**: 44–48. 25 Jan 1960.

Smith, J. H. & Gibson, P. B. The influence of temperature on growth and nodulation of white clover infected with bean yellow mosaic virus. Agron. Jour. **52**: 5–7. Jan 1960.

Standifer, Marie S. & Perry, V. G. Some effects of sting and stubby root nematodes on grapefruit roots. Phytopathology **50**: 152–156. 20 Feb 1960.

Stover, R. H. & Waite, B. H. Studies on *Fusarium* wilt of bananas. V. Pathogenicity and distribution of *F. oxysporum* f. *cubense* races 1 and 2. Canad. Jour. Bot. **38**: 51–61. *pl. 1.* Jan 1960.

Teliz-Ortiz, Moises & Burkholder, Walter H. A strain of *Pseudomonas fluorescens* antagonistic to *Pseudomonas phaseolicola* and other bacterial plant pathogens. Phytopathology **50**: 119–123. 20 Feb 1960.

Thomas, C. A. Rubis, D. D. & Black, D. C. Development of safflower varieties resistant to *Phytophthora* root rot. Phytopathology **50**: 129, 130. 20 Feb 1960.

Thomason, Ivan J. & Dickson, J. G. Influence of soil temperature on seedling blight of smooth bromegrass. Phytopathology **50**: 1–7. 25 Jan 1950.

Uritani, I., Uritani, M. & Yamada, H. Similar metabolic alterations induced in sweet potato by poisonous chemicals and by *Ceratostomella fimbriata*. Phytopathology **50**: 30–34. 25 Jan 1960.

Webb, R. E. *et al.* A new source of resistance to spinach blight. Phytopathology **50**: 54–56. 25 Jan 1960.

Williams, Lansing E. & Schmitthenner, A. F. Effect of growing crops and crop residues on soil fungi and seedling blights. Phytopathology **50**: 22–25. 25 Jan 1960.

Wilson, Charles L. Penetration and invasion of *Ceratocystis piceae* in white oak wood. Mycologia **51**: 311–317. Mai–Jun [Dec] 1959.

GENERAL BOTANY

(Including Biography and Nomenclature)

Angely, João. Autores dos binomios da flora do Brasil. Material para estudo da flora brasileira. Inst. Paran. Bol. Impado **12**: 1–22. 1959.

Angely, João. Bibliografia sôbre plântas tóxicas. Inst. Paran. Bol. Impado **14**: 1–15. 1960.

Angely, João. Geografia taxonômica do Paraná (Brasil). Inst. Paran. Bol. Impado **13**: 1–4. 1960.

Angely, João. Instituioçoes de botânica do Brasil. Inst. Paran. Bol. Impado **11**: 1–39. 1959.

Anon. Robert Emerson. 1903–1959. Jour. Gen. Physiol. **43**: i, ii. Nov [Dec] 1959.

Darlington, Philip J. Area, climate, and evolution. Evolution **13**: 488–510. Dec 1959.

Ewan, Joseph. Fougeroux de Bondaroy (1732–1789) and his projected revision of Duhamel du Monceau's *Traité* (1755) on trees and shrubs. Proc. Am. Philos. Soc. **103**: 807–818. 15 Dec 1959.

Geiser, S. W. Men of science in Texas, 1820–1880. Iv. Field & Lab. **23**: 111–160. Jul 1959 [Jan 1960]. V. 163–255. Oct 1959 [Feb 1960].

Johnson, T. Kenneth William Neatby, 1900–1958. Jour. Hered. **50**: 124–126. Mai–Jun [Nov] 1959.

Lourteig, A. Carlos A. O'Donell, 1912–1954. Lilloa **29**: 9–18. 15 Jul 1959.

McClung, Norvel M. Arthur J. Mix, 1888–1956. Phytopathology **49**: 771, 772. Nov 1959.

Peterson, John E. & Baker, Thomas J. An isolate of *Fusarium roseum* from human burns. Mycologia **51**: 453–456. Mai–Jun [Dec] 1959.

Rickett, H. W. & Stafleu, F. A. Nomina generica conservanda et rejicienda Spermatophytorum III. Taxon **8**: 282–314. 21 Dec 1959.

Schultes, Richard Evans. Etymologists loose amongst the orchids. Am. Orchid Soc. Bull. **29**: 86–93. Feb 1960.